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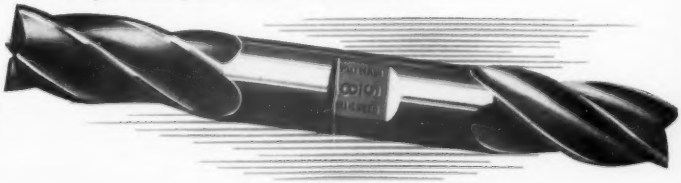

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NEXT MONTH

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"Plastics Tooling — Postwar". Coincidental with the greatly increased tooling costs prevailing today, is the progress that has been made in the field of plastics tooling. New materials and new methods are available today which permit the drawing and forming of heavier stock than heretofore workable with plastics tools. This article is the first of a series which will bring to the reader the latest plastics tooling know-how.

•

"Die Design for Symmetrical Brackets", Part II, by Hans Effgen, M.E., Globe Tool & Gage Works, Boston, Mass. Continuing from our September issue, Mr. Effgen presents the design considerations necessary for producing brackets with more intricate bends, as well as the design theory involved in the several examples shown. Bend allowances, cut-off calculations and hole positioning are thoroughly detailed.

•

"Die Casting Die Design", Part II, by H. K. Barton and J. L. Erickson. In this resumption of their die casting die design series, the authors present the involved subject of die cores. "One of the greatest challenges to the die designer is to design dies for parts calling for extensive coring at low cost. Indeed, the ingenuity the designer displays in designing his dies determines not only the cost of the dies but the efficiency, and therefore the expense, of operating the die in service". Barton and Erickson proceed with the know-how and show-how essential to successful coring.

•

"Screw Machine Tooling", by H. C. Tsien, Engineer, The Warner & Swasey Co., Cleveland, Ohio. We plan to present, finally, the first of the prize-winning articles from the contest sponsored by TOOL & DIE JOURNAL during the 1948 ASTE Tool Show. This features the turret lathe setup sheets, drawings and detailed descriptions of the necessary tooling for two screw-machine workpieces.

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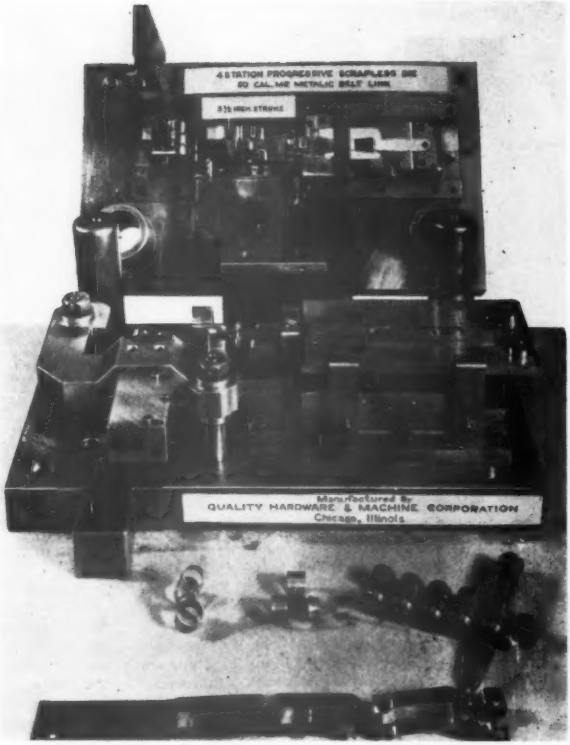

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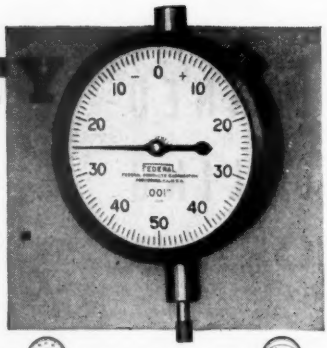

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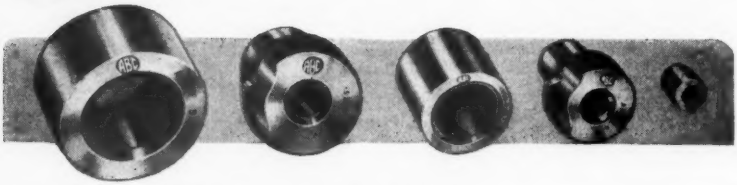

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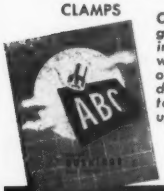

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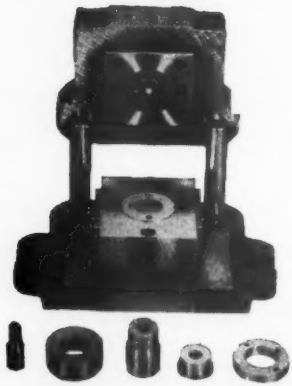

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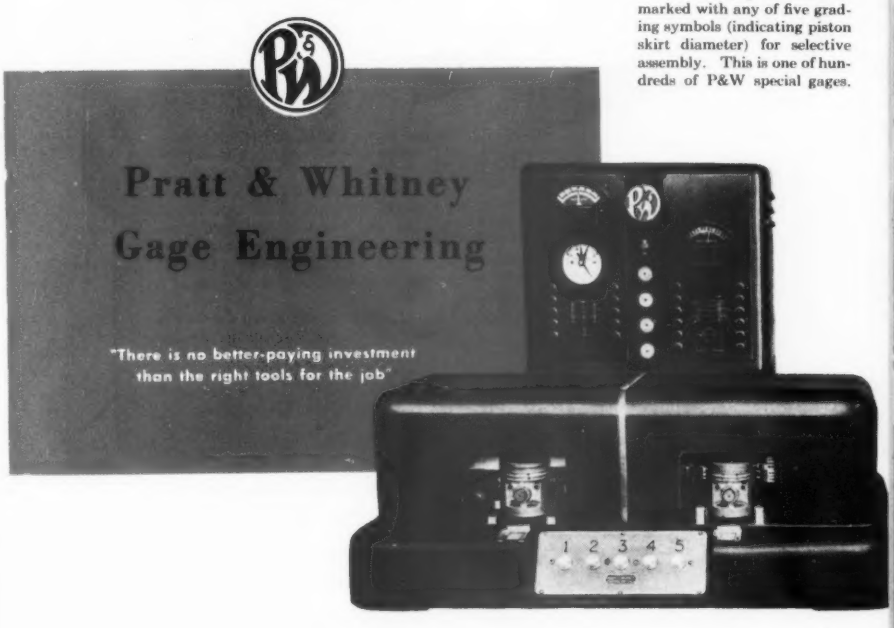

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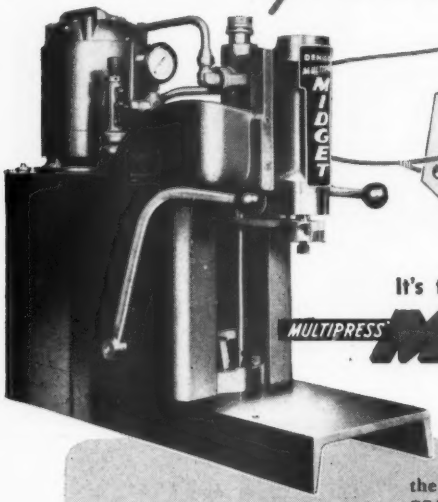

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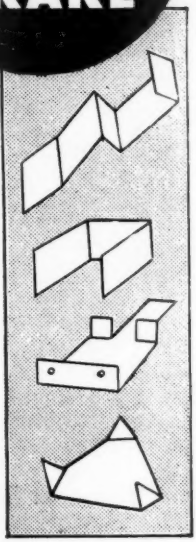

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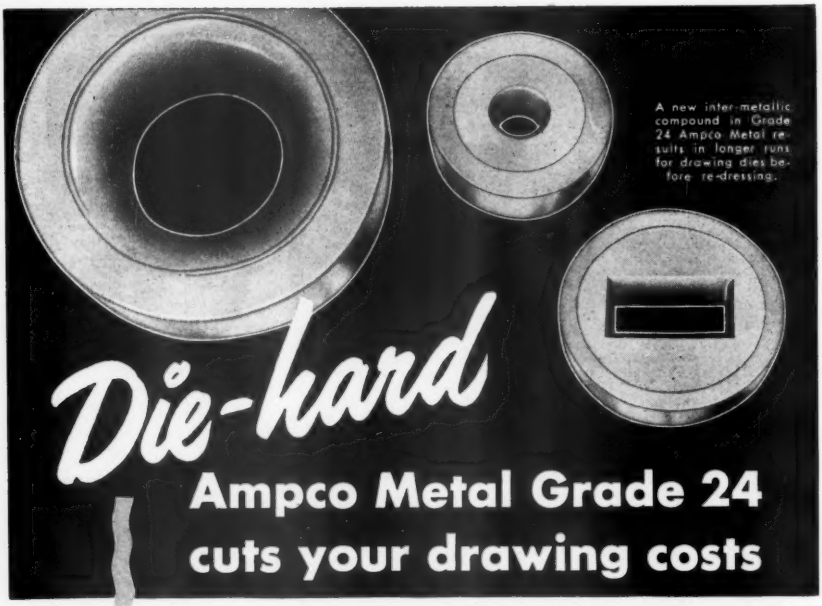

A new inter-metallic compound in Grade 24 Ampco Metal results in longer runs for drawing dies before re-dressing.
Die-hard
Ampco Metal Grade 24
cuts your drawing costs

Gives longer runs before re-dressing — no galling and loading on stainless steel

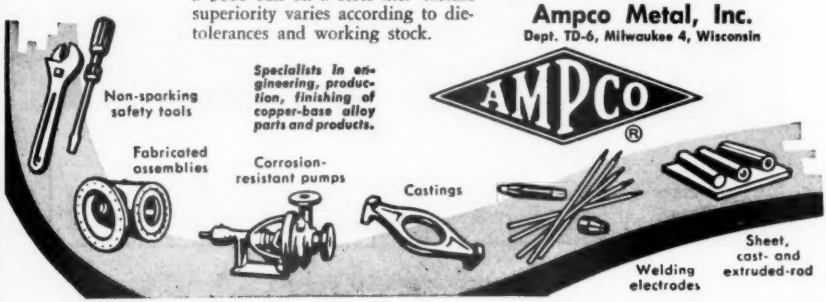
Dozens of shops have tested this new alloy. They *proved* that Grade 24 gives you 2 to 5 times the die life previously considered standard.

Grade 24 Ampco Metal dies are superior to steel dies on many jobs, especially stainless steel. A typical test case showed a 77,000 run on an Ampco Metal die, compared to a 3000 run on a steel die. Actual superiority varies according to die-tolerances and working stock.

Ampco Metal Grade 24 gives you more hardness and compressive strength than any other bronze. Machinability of Grade 24 is about the same as that of Grade 22 which you have used in the past.

See your nearby Ampco engineer today, for the complete cost-cutting story on Grade 24! Write for bulletin giving full details.

Ampco Metal, Inc.
Dept. TD-6, Milwaukee 4, Wisconsin



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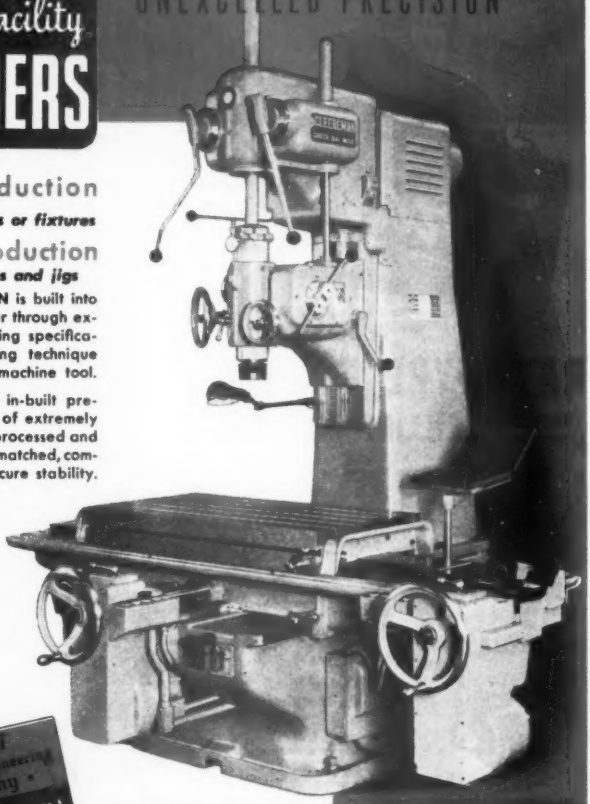
CLEEREMAN

UNEXCELLED PRECISION

PRECISION with STAMINA and *Operating Facility*

JIG BORERS



Small Lot Production

without layout time, jigs or fixtures

Tool Room Production

of accurate tools, dies and jigs

UNEXCELLED PRECISION is built into every Cleereman Jig Borer through excellence of design, exacting specifications and a manufacturing technique which assures a precise machine tool.

STAMINA maintains this in-built precision through a long life of extremely accurate work. Specially processed and tested materials, properly matched, combat wear of ways and secure stability.

OPERATING FACILITY is widely recognized as characteristic of all Cleereman machine tools. Prepositioning power rapid traverse or electronic traverse and milling control accessories speed operation.

Wire or write for catalog with complete specifications.

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CLEEREMAN MACHINE TOOL CO. Green Bay, Wis.

BUILDERS OF PRECISION JIG BORERS & DRILLING MACHINES

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YOU DON'T HAVE TO STAND ON YOUR HEAD

... to do a difficult job on a

FRAY Miller!

All-Angle

Fray

Precision

RAM TYPE NO. 7-B

VERTICAL UNIVERSAL **MILLING MACHINE**

- Flexible
- Sturdy
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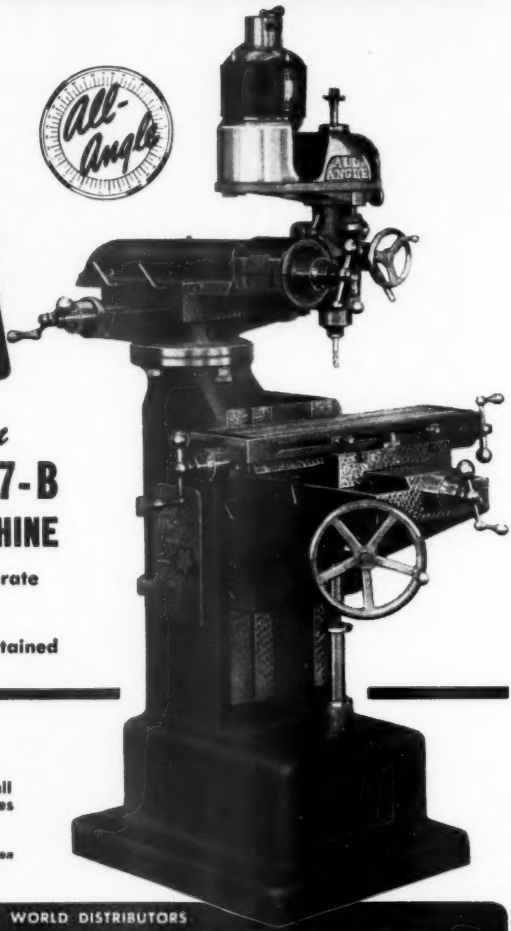
- Easy to Operate
- One set up
- All angles quickly obtained

- Four sizes
- Four types
- Adaptable to all Milling Machines

For further information write Dept. E



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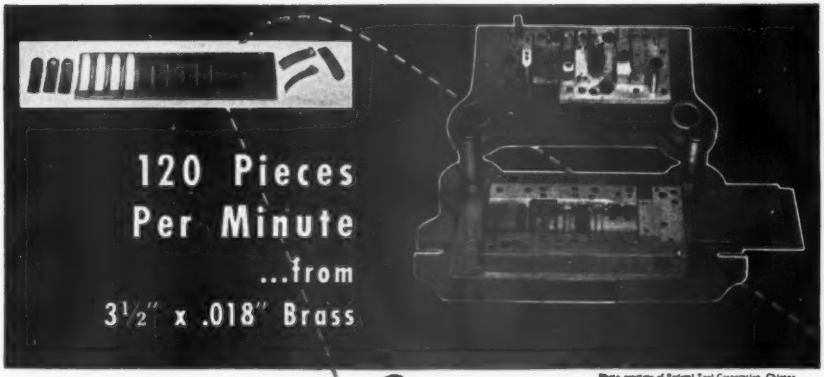

Photo courtesy of Federal Tool Corporation, Chicago

...using DANLY Precision Die Set

Save Time...

Use DANLY Nation-Wide Die Set Assembly Service

Assembly plants (marked with stars) stock interchangeable parts for quick assembly and delivery of any standard die set to your specifications.

- **Chicago 50,** 2100 S. 52nd Ave.
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Precision Guiding Required on Deep Blanking Tool

Here is another example of how Danly Precision Die Sets help maintain accurate punch and die relationship on high production work. The part illustrated, a slide cover, is produced at a rate of 120 pieces per minute on the 11-station progressive die and a Danly Standard Precision Semi-Steel Die Set.

An unusual deep blanking tool used in the last station requires precision guiding by the Danly Die Set to prevent breakdowns and assure peak performance. The blanking punch at this station enters the die a distance of 5/16".

Sequence of Operations

Brass coil stock, 3½" wide x .018" thick, is automatically fed through the following operations: Pierce pilot hole, slit, first form, idle, draw shape, pilot, restrike shape, pierce, idle, blank, pilot in scrap.

To date, over 3,000,000 pieces have been produced with the same Danly Die Set. An average of 200,000 pieces per grind is obtained.

Helpful Engineering Service — For helpful engineering service on die sets of any size, standard or special, for any type of press operation, consult Danly without obligation.

get this *free* bulletin

Illustrates how Danly special machining and welding facilities help you save time and money on special die set applications.

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25 YEARS OF DEPENDABLE SERVICE TO THE STAMPING INDUSTRY

PRECISION DIE SETS, STANDARD AND SPECIAL • MECHANICAL PRESSES AND PRESS EQUIPMENT

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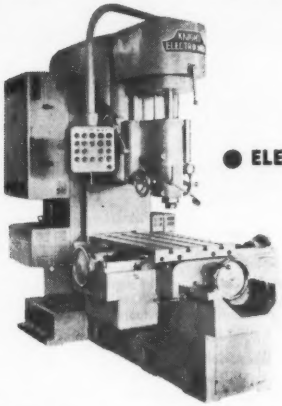
NEW! KNIGHT EQUIPMENT

. . to Boost Output and Lower Costs



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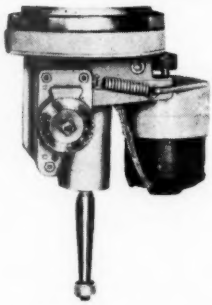
Efficiently, economically handles large capacity work of many types: jigs, metal patterns, multi-cavity molds, jig boring with dial indicator, drilling, milling, machining light metals, etc. Infinitely variable range of speeds and feeds. Any combination of speeds and feed controls can be supplied or eliminated subject to customers requirements.



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Accurately and quickly finishes holes and bores up to 6" diameter in hardened parts. Simplifies handling work too large to swing in standard machines. Special adaptors permit easy installation on any milling machine.

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Magnetic chuck on Hanchett grinder holds two die beds (58" x 58" each) for vertical surface grinding to a satin finish.

There's no need to "roll your own" when Producto can supply you with Specials of the highest quality in the shortest time.

Through long experience, we have developed custom-built machinery, specifically geared to handle close tolerance work on all types of die-sets from small, intricate designs to giants of several tons.

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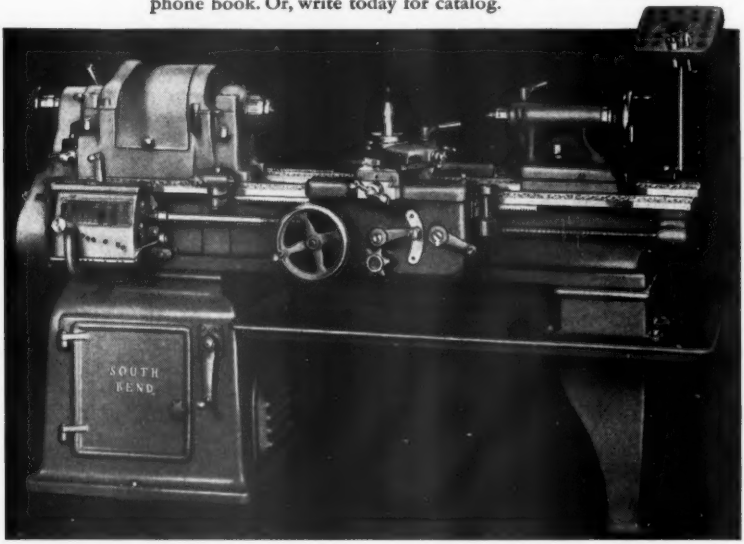
SOUTH BEND PRECISION LATHES have solved the production of precision parts for many manufacturers. Their accuracy, speed and adaptability to a wide range of operations contribute to efficient machining. Perhaps you are running some small, precision jobs on slow, heavy machines. If so, find out about South Bend Precision Lathes. These are the kind of jobs for which they are built. Their use can often effect appreciable savings. And, being reasonable in price, they can be installed without excessive capital investment.

Call our local distributor for information. His name is listed under "Machine Tools" or "Lathes" in your classified phone book. Or, write today for catalog.



16" x 6' TOOLROOM LATHE with handwheel collet attachment; collet rack; taper attachment; micrometer carriage stop; chip pan; thread dial; 3 phase, 60 cycle, 220 volt motor; and drum switch. Catalog No. 8117-C. **$2145.25**

PRICES OF SOUTH BEND LATHES

LATHE SIZE	QUICK CHANGE GEAR MODEL	TOOLROOM MODEL
16" x 6' Lathe	$1729.25	$2145.25
14½" x 5' Lathe	1466.25	1843.25
13" x 5' Lathe	1227.25	1577.25
10" x 3' Lathe	924.35	1231.35
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Prices include 3 ph., 60 cy., A.C. motor and drum switch — f.o.b. factory

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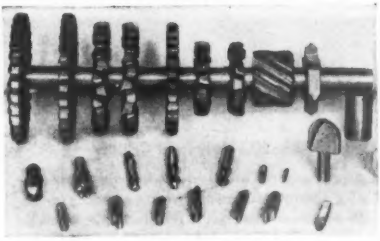
BETTER THAN ASPIRIN FOR GRINDING ROOM HEADACHES!



Here are a few standard cutting tools that have been ground on the Radiform into special forms.

The Radi-Form is a small grinder attachment — the secret of which is that IT CAN MOVE THE WORK IN A PREDETERMINED ARC OF ANY DESIRED RADIUS. (From 1 16 to 2″ concave, and from .00 to 2″ convex.)

This means that you can now form spiral fluted end mills and similar rotary cutting tools to within .0005 accuracy if desired. You can generate radii on carbide tipped cutting tools WITHOUT FIRST FORMING A WHEEL. A standard cupped diamond wheel will serve for all your tricky grinding problems.

Here is unbelievable accuracy coupled with unheard of ease . . . cutting tool grinding made simple, quick and accurate. The Radi-Form can also, with ease and accuracy, pre-form grinding wheels for plunge grinding.

The Radi-Form grinder attachment sells for a surprisingly low price and earns its keep in a hurry. Write for literature and prices.

W. F. MEYERS COMPANY · ESTABLISHED 1888

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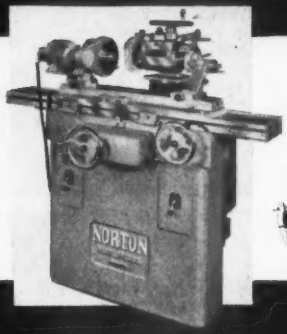
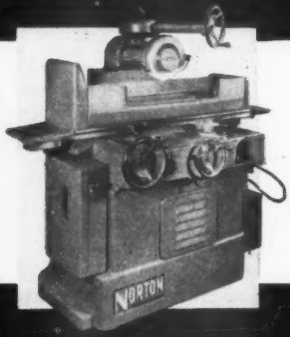
3 new NORTON GRINDERS

For the TOOL ROOM



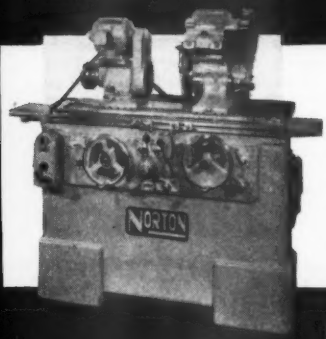
No. 20 Cutter and Tool Grinder

THIS easily-operated, hand-feed grinder has a unique design of tilting wheel head that simplifies many operations. It has dual front and rear controls that provide maximum convenience of operation in the grinding and sharpening of all the commonly used cutters, reamers and counterbores with speed and accuracy. Special attachments are available for the more unusual types of work. Wheel head swivels 360°.



8" x 24" Surface Grinder

AN HYDRAULIC precision grinder of the traversing table type with horizontal wheel spindle. Both hand and hydraulic table traverse and cross feeds contribute to the versatility of this machine for either toolroom grinding or efficient production work. Smooth operation of all moving parts, convenient placement of controls, and easy accessibility of maintenance points, characterize this new surface grinder. Either wet or dry grinding arrangements are available.



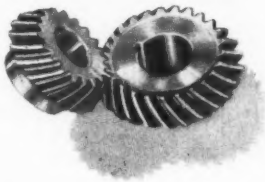
10" x 20" Universal Grinder

A SMALL universal grinder particularly recommended for general toolroom or production grinding where a high degree of precision is required. Outstanding versatility is provided by independently motored and hinged internal grinding head, universal live spindle or dead center headstock, double slides and swivels for wheel head, and convenient arrangement of controls and adjustments.

M-984

NORTON GRINDERS and Lappers

NORTON COMPANY, WORCESTER 6, MASS. *Distributors in All Principal Cities*



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GEAR Specialties

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Advanced Leadership in Design and Engineering

★ FIRST for Precision with Ruggedness...
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SAFETY DEVICE

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THE LINE ON WHICH TO STANDARDIZE FOR A HIGHER STANDARD OF RESULTS

Another LATROBE first!

LATROBE DESEGATIZED BRAND OF DISPERSED-SEGREGATE HIGH SPEED STEELS

Designed for Intermediate Service

... where the full properties of the more costly higher alloy high speed steels are not required!

This new **ELECTRITE MV** family of high speed steels is the product of years of research by Latrobe Electric Steel Co. metallurgists. Developed specifically to fill the need for Intermediate Alloy High Speed Steels, the **MV** family is suitable for uses where higher alloys are not required.

The introduction of these new steels marks another step forward in Latrobe's continuing efforts to produce for Industry better steels for better tools at lower cost.

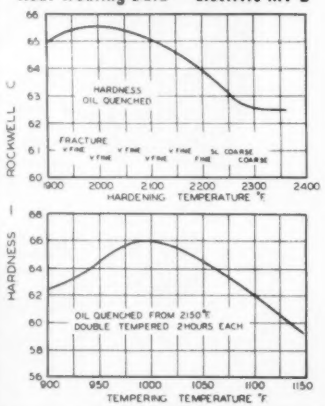
These intermediate high speed steels are recommended for small drills and reamers, thread chasers, taps, pipe taps, etc., wood-working knives and cutters and for body stock for carbide-tipped drills and reamers. Our sales engineers will be glad to assist you in selecting the proper grade for your particular applications.

LATROBE ELECTRIC STEEL CO., Latrobe, Pa.

		C	Cr	Mo	Va
TYPICAL ANALYSES	MV-1	.80	4.10	4.25	1.10
	MV-2	.88	4.10	4.25	2.00
	MV-3	1.18	4.10	4.25	3.15
	MV-4	1.40	4.10	4.25	4.15

Shown at right are hardening and tempering curves of MV-2 grade.

Heat Treating Data — Electrite MV-2



R-B INTERCHANGEABLE PUNCHES and DIES

Proved BY YEARS OF USE

in DIE-BUILDING . . . *in* PRESS OPERATION

Die-makers and press operators everywhere understand the application and use of R-B Interchangeable Punches and Dies—because, for years, these products have been "standard" in the metal-working and plastics industries. As a result, man-hours and money are saved in die-building . . . and press operators have learned how to install and remove them quickly and easily *in the press,* reducing press "down-time" to a minimum. Used exclusively in many plants, they provide a *sure* solution to *simplified* inventories of punches and dies.

R-B punches and dies of standard sizes, shapes and materials are carried in stock for immediate delivery. Special punches and dies are made promptly to your specifications.

Get the WHOLE *Story*

in this free catalog.

A 48 page book containing full information on Allied's "one stop service." Write for your copy.

. . . and CHECK THESE R-B ADVANTAGES

- ✓ Simple in design and construction.
- ✓ Unlike most parts used in die construction, R-B products have a salvage value.
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- ✓ Selected steels with hardness controlled and finished to very close tolerances insure uniformity.
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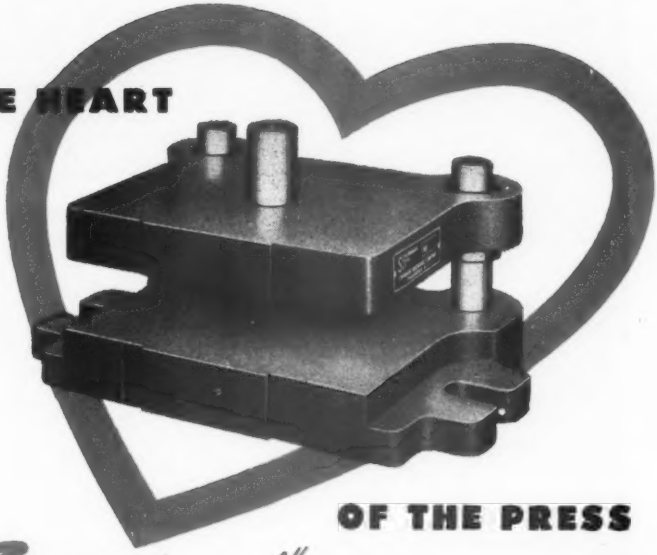

"Standard" STEEL DIE SETS

- Decrease set-up time; lengthen tool life.
- Used with any make of press.
- All parts strictly interchangeable.
- Prompt shipment on all catalog sizes.

Ask for catalog

STANDARD MACHINERY COMPANY

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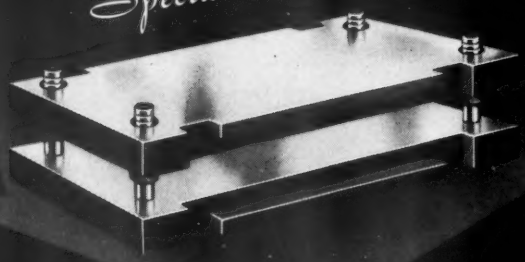

Our production facilities are employed *exclusively* in the design and fabrication of standard and special steel and semi-steel die sets. "DETROIT" specialization guarantees dependable, prompt service and workmanship of the highest quality on both standard and special jobs. "DETROIT" die sets are Micro-metric machined to assure long die life and consistently satisfactory operation.

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DETROIT DIE SETS ★

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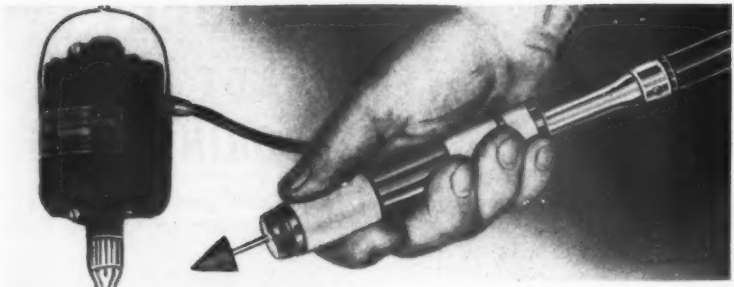

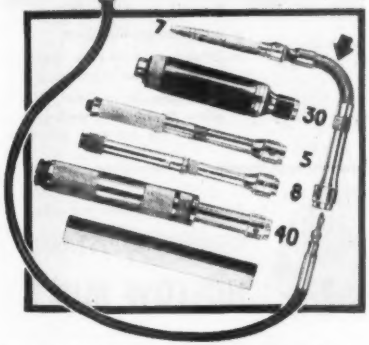

5 quickly interchangeable handpieces types — pencil sizes and larger — some with flexible wrist — see arrow.

FOREDOMS are TOPS

Here are 4 REASONS WHY:

1. Extra power and longer motor life because motor not dwarfed to fit hand. 2. Correct handpiece size for deft, sensitive, finger-tip control. 3. Complete range of handpieces types. You fit the tool to job at hand. 4. Small handpiece size lets you get into those "hard-to-reach" places.

USE FOREDOMS to grind, polish, drill, rout, mill, saw, slot, clean, sand, etch, engrave, etc. FOREDOMS are profitable additions to all departments—production, maintenance, or tool. The FOREDOM line includes "hang-up" models as illustrated and easily-portable bench models. Foot rheostat is standard with most of them.

Our catalog N-1710 gives you valuable information as to how you can profitably employ FOREDOMS. It will pay you to send for it.

Foredom
FLEXIBLE SHAFT MACHINES
SOLVE MANY PRODUCTION AND MAINTENANCE PROBLEMS

FOREDOM ELECTRIC CO.,
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Please send us your catalog No. N-1710, showing the different uses of FOREDOM Flexible Shaft Machines.
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Address.....
City & Zone.....State.....

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STEP UP YOUR PRODUCTION WITH GENESEE

INSERTED BLADE FACING and COUNTERBORING TOOLS

Production goes up and cost goes down when you use Genesee Facing and Counterboring tools. These features will convince you.

- Chip space is 100% efficient no matter how often blades are reground.
- Two styles with straight or morse taper shanks carried in stock.
- Standard sizes from 1¼ to 4 diameter.
- Furnished with high speed steel, cast-alloy or Tungsten Carbide tipped blades.
- Interchangeable pilots.
- Blades may be reset to exact diameter after regrinding.
- All tools have heat treated alloy steel bodies with ground thread for extreme accuracy.

Facing and Counterboring Tool

Another production increaser

GENESEE ADJUSTABLE HOLLOW MILLS

Let our Engineering Department solve your Production Tool Problems.

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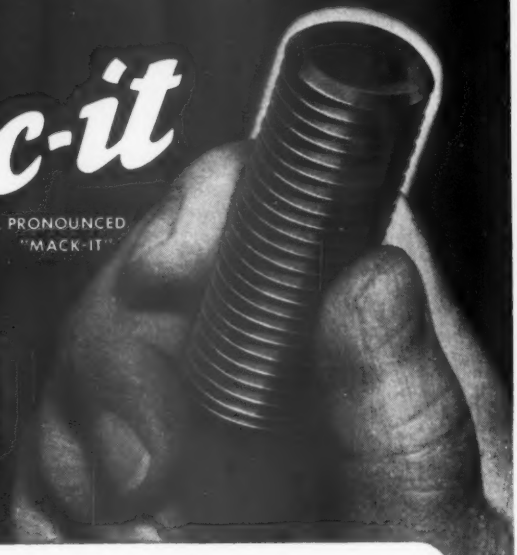
IT'S A *Mac-it*

PRONOUNCED "MACK-IT"



Mac-it ⅜" x 2½" Hollow Set Screws have grip of more than 17,000 pounds.

BETTER, FASTER SERVICE WITH THIS *Complete* MAC-IT LINE!

Because many standard types of Mac-its are stocked throughout the country for quick delivery, and because specials can be engineered to your own specifications, you'll find it pays to investigate Mac-its *first.*

Mac-it's 35 years' experience in the manufacture of heat-treated, alloy steel screws is your assurance of precision, uniformity and strength. Sold through leading industrial distributors from coast to coast and in Canada. Write for new catalog today!

Other Mac-it products include:

Hollow Lock Screws
Socket Head Cap Screws
Stripper Bolts
Hollow Pipe Plugs
Socket Screw Keys
Square Head Set Screws
Hexagon Head Cap Screws
. . . and many others

Marketed Nationally Since 1913 by

STRONG, CARLISLE & HAMMOND COMPANY

Cleveland 13, Ohio

Manufactured by MAC-IT PARTS COMPANY, Lancaster, Pa.

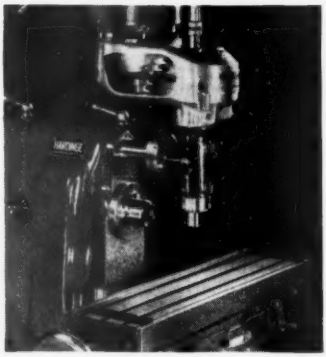
SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

HARDINGE
ELMIRA, N.Y.

HIGH SPEED PRECISION
MILLING MACHINE
FOR
TOOL ROOM AND LABORATORY

Tool room and laboratory work, because of the variety, demands useful milling machine attachments. Hardinge knows this. Illustrated are two attachments in addition to the arbor and vise shown below. Other attachments are: Power feed for table; oil coolant facilities; 360° swivel base, also right angle base for dividing head; taper hole collets,as well as regular collets; step chucks and jaw chucks for dividing head.

Write for Bulletin TM-UM



Modern design universal plain dividing head and tailstock. Designed to match the precision qualities of the machine. Features are: Preloaded ball bearing spindle; takes standard 1" capacity collets same as used in horizontal spindle; and high speed indexing, 4 to 1 ratio.

This attachment provides high speed vertical milling. Has separate motor driven preloaded ball bearing spindle — eight selective speeds from 465 to 4250 r.p.m.—takes standard ½" capacity collets. Vertical head swivels to angular settings.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Offices in principal cities. Export office: 269 Lafayette St., New York 12, N. Y.

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

BOYAR-SCHULTZ PROFILE GRINDERS

Fast, Accurate CONTOUR GRINDING

IN THE TOOL ROOM...IN PRODUCTION

Boyar-Schultz Profile Grinders save time in grinding inside and outside contours, irregularly shaped profiles, die clearances and many other difficult grinding tasks.

Boyar-Schultz No. 2 Profile Grinder
A heavy duty floor model available with single or dual spindles which turn at 10,000 R.P.M. with vertical oscillations. Rapid stock removal even with wheels as small as ½" diameter. Uses wheels ½" to 3"

Boyar-Schultz No. 1 Profile Grinder
Bench model. Spindle speed of 20,000 R.P.M. with vertical oscillations. Accommodates wheels ⅛" to 1" diameter. A highly efficient tool that performs in minutes, much of the work that formerly required hours.

Boyar-Schultz CORPORATION

2112 WALNUT STREET **CHICAGO 12, ILLINOIS**

FOR MORE PROFITABLE PRODUCTION

Precision Ground Sectional Dies

- Tungsten Carbide or Steel Applications

DIES

Lamination
Piercing and Blanking
Compound
Perforating

FORM TOOLS

Circular
Dovetail
Flat

GAGES, JIGS, and FIXTURES

To suit your most exacting requirements.

Progressive Die designed and made for high production of motor laminations.

● **Our compact modern plant, equipped with the finest precision tools, combines skilled engineering, workmanship and experience in satisfying national and export requirements.**

Cleveland FORM TOOL COMPANY

6514 St. Clair Avenue
Cleveland 3, Ohio
EXpress 0189

SEND FOR THIS Hammond CARBIDE TOOL GRINDER CATALOG

THIS 8½"x11" CATALOG contains "Helpful Suggestions" on the handling and grinding of Carbide Tools and shows our complete line of Chip Breaker and Carbide Tool Grinders. Mail coupon today. Catalog No. 220 will be sent promptly.

HAMMOND MACHINERY BUILDERS, Inc.
1631 DOUGLAS AVENUE, KALAMAZOO, MICHIGAN

YES we are interested. Please send us a free copy of Carbide Tool Grinder Catalog No. 220.

Company Name _____ Title _____

Individual _____

Address _____

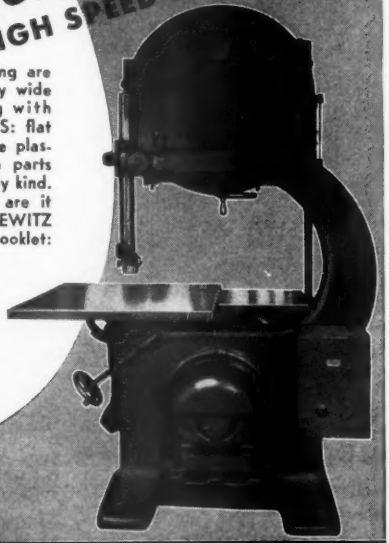
City _____ Zone _____ State _____

for Sawing **METAL** *as* **HARD** *as a* **FILE**
or Trimming **FORMED PARTS**
- FAST!

Actual photo of file friction sawn on Tannewitz High Speed Band Saw.

Tannewitz
HIGH SPEED BAND SAWS

Cost reductions that are downright amazing are effected in the cutting of an extremely wide variety of materials by friction sawing with TANNEWITZ HIGH SPEED BAND SAWS: flat sheets, hardened or soft steels, armor plate plastics, and many others. Formed aluminum parts can be trimmed without using a rest of any kind. Whatever your cutting problem, chances are it can be done faster and better with TANNEWITZ HIGH SPEED BAND SAWS. Write for booklet: "FRICTION SAWING."



THE TANNEWITZ WORKS
GRAND RAPIDS 4, MICHIGAN

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Starrett

INSPECTOR'S DIAL BENCH GAGE NO. 654

Among the many outstanding applications of Starrett Dial Indicators to quality control procedures, Starrett No. 654 Dial Bench Gage offers many advantages. The adjustable table and lateral and fine perpendicular adjustment of the sliding head provides the flexibility needed for rapid adaptability to a wide range of applications.

Any style of indicator can be furnished. When equipped with Starrett Indicator No. 25-T5 (0-5-0, reading .0001") fitted with tell-tale hand and top lift lever, the maximum in speed, accuracy and convenience is provided for taking close measurements on a series of work pieces. Starrett No. 25-T1 is another popular indicator widely used for this application.

For a complete description of Starrett Dial Bench Gage No. 654 and the many Starrett Dial Indicators for quality control, see Starrett Dial Indicator Catalog TD. Write for a copy.

Starrett No. 25-T-1 Dial Indicator
Reads 0-5-0 by ten-thousandths, range .025. Can be furnished with tolerance hands to show plus and minus limits.

Starrett No. 25-T5 Dial Indicator
A long range indicator reading .050, graduated .001", range .200", with double dial and tell-tale hand.

STARRETT — MECHANICS' HAND MEASURING TOOLS AND PRECISION INSTRUMENTS · DIAL INDICATORS · STEEL TAPES · HACKSAWS AND BAND SAWS · PRECISION GROUND FLAT STOCK
Buy Through Your Distributor

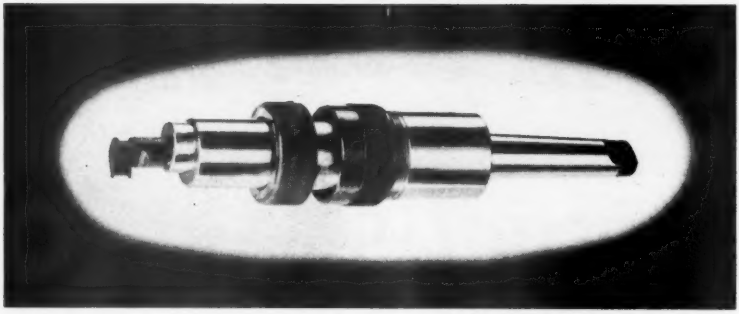
THE L. S. STARRETT CO. *World's Greatest Toolmakers* · **ATHOL, MASSACHUSETTS, U.S.A.**

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

RECESSING TOOLS

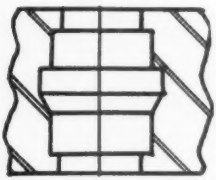
AN OLD NAME . . . A NEW TOOL

by MAXWELL

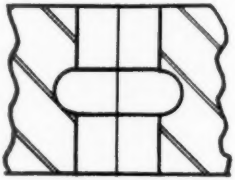


THIS is another Max-WELL-Made tool. It is designed especially to fit any and all jig and fixture setups, and is available in three sizes which have working range of from ½ to $2\frac{3}{16}$ inches. Tools operate into standard bushings and can be used on any automatic or manual spindle.

THERE is a Maxwell Recessing Tool for your job whether you do the work with a



DRILL PRESS, RADIAL DRILL, TURRET, CHUCKER, AUTOMATIC OR SPECIAL SPINDLES.



INTERCHANGEABLE shanks and cutters provide this reasonably priced tool with wide range of application. Tools are available for immediate delivery. Write for full details or send your specifications and let our engineers recommend the proper Max-WELL-Made Recessing Tool.

THE MAXWELL COMPANY

9220 BROADWAY • **BEDFORD, OHIO**

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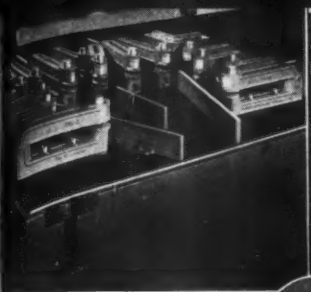
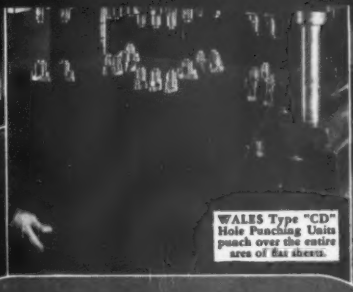


WALES Type "BL" Hole Punching Units punch round and shaped holes in flat sheets.



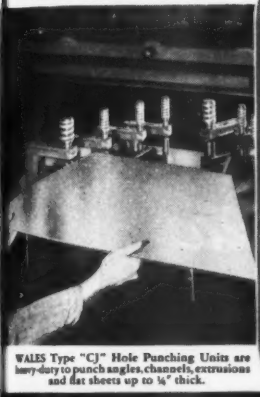
WALES Type "CD" Hole Punching Units punch over the entire area of flat sheets.

WALES Type "C" Hole Punching Units pur angles, channels, extrusions and flat sheet

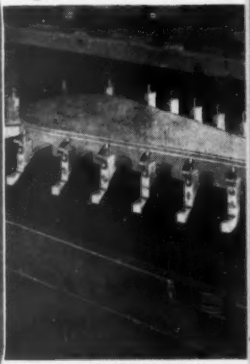
WALES

HOLE PUNCHING AND NOTCHING EQUIPMENT

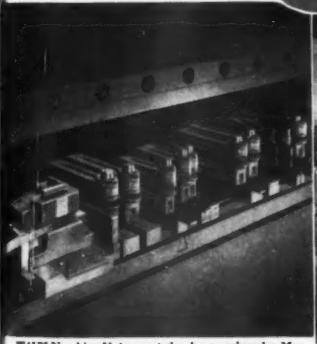
...the most complete line in America



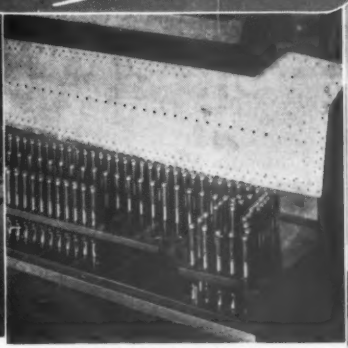
WALES Type "CJ" Hole Punching Units are heavy-duty to punch angles, channels, extrusions and flat sheets up to ½" thick.



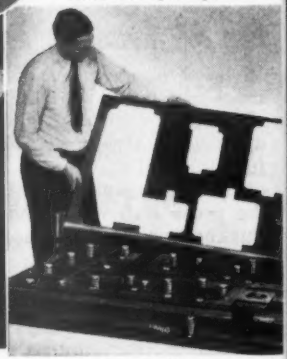
WALES Type "H" Hole Punching Units pur holes horizontally in flanges and rims.



WALES Notching Units notch flat sheets and angles. May be used in setups with Type "BL" Units for punching and notching in same operation.



WALES Plate Set System for punching holes over the entire area of flat sheets.



WALES Strippits strip metal from conventional d

The above complete line of hole punching and notching equipment is one reason why so many manufacturers standardize on Wales Units for *long and short production runs.* In fact, many have adopted this standard practice rule:—Before putting holes in angles, channels or sheets by any method, call on Wales-Strippit FIRST.

For the complete story on this stamping press and press brake tooling equipment, write for fully-illustrated catalogs.

WALES-STRIPPIT CORPORATION

GEORGE F. WALES, *President*

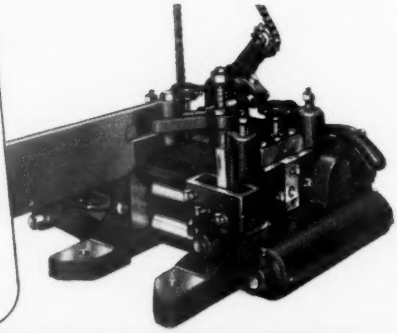
355 PAYNE AVENUE, NORTH TONAWANDA, N. Y.

(*Between Buffalo and Niagara Falls*)

WALES-STRIPPIT OF CANADA, LTD., HAMILTON, ONTARIO

Specialists in Punching and Notching Equipment

Assures Fast
Safe-Accurate
Feeding of
Coiled Strip Stock



WITTEK *Automatic*
ROLL FEEDS AND REEL STANDS

For All Types of Punch Presses

Wittek *Automatic* Roll Feeds provide maximum efficiency in the high speed automatic feeding of all types of coiled strip stock to punch presses. Highly flexible in function and application, they are capable of feeding lengths up to 24" per stroke of the press and will handle various stock thicknesses in widths up to the maximum width of the rollers.

Wittek *Adjustable* Reel Stands provide automatically expanding coil holders that center the coil and assure maximum production by eliminating looping, tangling and back lash of stock. If your production problem involves feeding coiled stock to punch presses, consult us. Your inquiry will be given immediate attention. Ask for completely descriptive catalog.

WITTEK Manufacturing Co.
4305 W. 24th Place, Chicago 23, Illinois

Automatic
ROLL FEEDS
and
REEL STANDS

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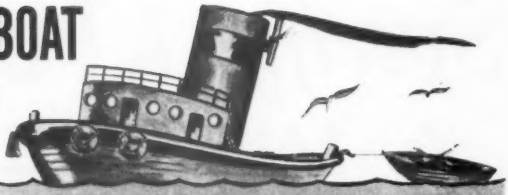
WHY USE A TUGBOAT

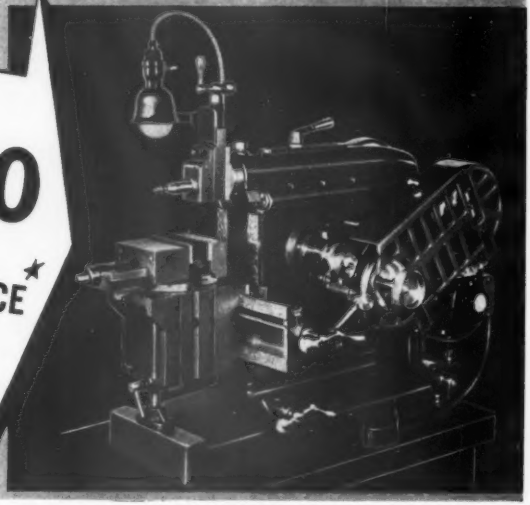
TO PULL A ROW BOAT

. . . and



WHY BUY A BIG COSTLY SHAPER . . . *when*

THE **AMMCO** WILL GIVE YOU TOP PERFORMANCE ★ UP TO 7"?



★ NO BIG SHAPER CAN BEAT THE AMMCO FOR ★ ACCURACY ★ VERSATILITY ★ SPEED ★ ECONOMY

Here is America's No. 1 Precision Shaper for all work up to 7". It is accurate—vibrationless, and on many jobs requires as little as two to three minutes set-up time. It handles a wide variety of work and cuts cost, saves time and labor.

The Ammco is a rugged machine—built for continuous operation—shaping jobs can be handled at lower cost and faster with the AMMCO—and it will take care of 75% of shaping requirements in most plants. It has the features of larger, more expensive machines plus economy of operation—you can't afford to be without one or more.

Write for full information and a copy of our new shaper catalog No. TD 1048

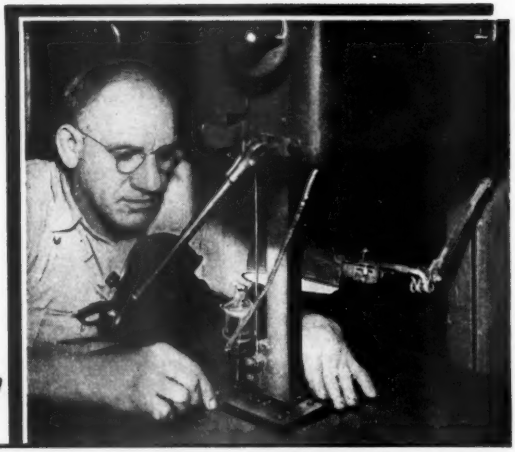
You can do it Better and Faster with AMMCO *Skill is Built into Every Ammco Product*

AMMCO TOOLS, INC. • COMMONWEALTH AVE. • NORTH CHICAGO, ILL.

Specify ATLANTIC

BAND SAW BLADES

for Smoother

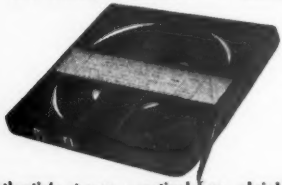


CONTOUR CUTTING

ATLANTIC SAWS meet all of your requirements for a superior blade on complicated die and fixture radius cutting. ATLANTIC specializes in accurate milled and precision set teeth, hardened to exact temper.

ATLANTIC'S special alloy steel insures longer wear and easier welding.

ATLANTIC'S one temper saw for all metals reduces stock you have to carry. Cut to length and welded, ready for use. Packed in strong Atlantic box. Write for new Atlantic Catalog.



Atlantic's strong, practical box, plainly marked on sides and top. Remains in good condition until entire coil is used.

Atlantic Saw Mfg. Co.

INCORPORATED

Exclusively Manufacturers of Band Saw Blades

160 Brewery St., New Haven, Conn.

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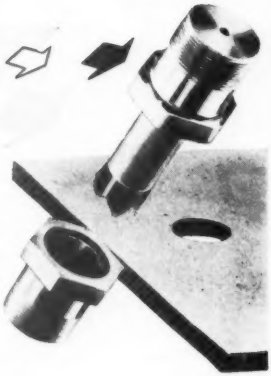
Get Far Greater Press Output!

on SIMPLE work...

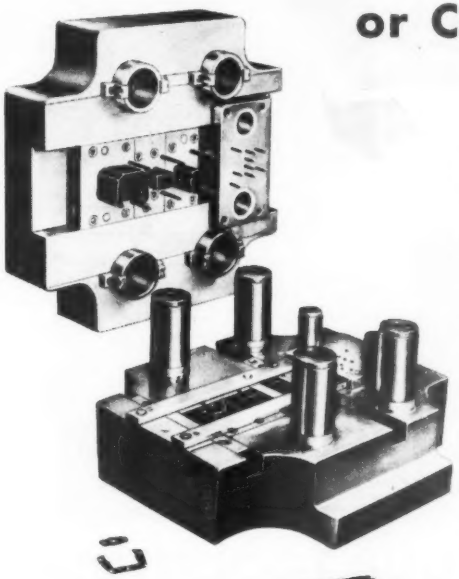


On a simple punching operation, this Carboloy punch and die lasted 12 times longer than its steel predecessor! In punching holes through abrasive Plaster Wallboard, steel dies wore .012" to .015" every 170 hours . . .

. . . while dies and punches of Carboloy Cemented Carbide show wear of only .0025" to .003" after 380 hours of continuous operation!

The Carboloy dies are bringing savings, not only in replacement costs, but in replacement time, as well.

or COMPLEX...



In complex dies, too, Carboloy brings the same longer die life, lower replacement costs and downtime, finer tolerances, better finishes.

This complex, five-station progressive die is an example. With unbelievable accuracy and efficiency, it produces millions of rotor and stator laminations.

Whether you need standard dies available from Carboloy; simple Carboloy dies that you can make in your own shop; or complex dies available through many die shops, you will find that Carboloy brings you advantages in drawing, cupping or blanking that you can find nowhere else.

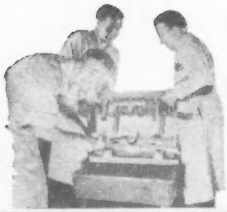
A Carboloy engineer will gladly call on you any time to help you with any problem. Send for the Carboloy DIE ENGINEERING MANUAL, D-124, to find out more about the advantages Carboloy Cemented Carbide can give you.

CARBOLOY COMPANY, INC.
11111 E. 8 Mile Ave. Detroit 32, Michigan

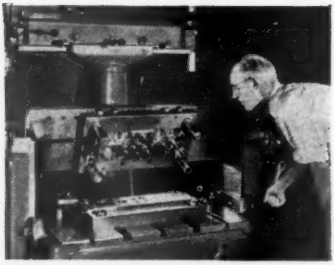
FOR GREATER PRESS OUTPUT

SPECIFY **CARBOLOY**®
CEMENTED CARBIDE DIES

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS



Hand methods are slow and costly.



With the Moore Die Flipper 1 man does the work of 3.

Die assembling now mechanized

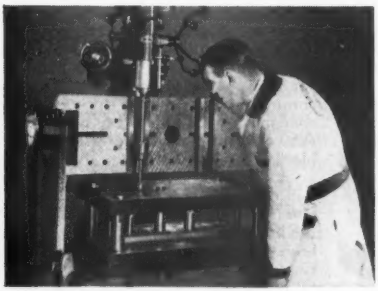
Is your toolroom still in the grunt-and-groan era of trying out and assembling large dies? Then it's time you investigated the revolutionary new Moore Die Flipper.

Without physical effort one diemaker can perform all the operations of die-assembling: Take apart, turn over, drill, tap and try out. The Die Flipper will be a money-saver in your toolroom from the start, for it can also be kept busy as a radial drill.

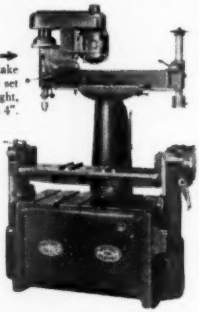
An eight-page catalog, with over 20 photographs and drawings, is just off the press. It's yours for the asking.

MOORE SPECIAL TOOL COMPANY, INC.
726 UNION AVENUE BRIDGEPORT 7 CONNECTICUT

Drilling punch in place. Spring holes are also drilled. Radial drill has 1½" capacity. Tapping is done in same set-up with Lassy Tap Set.



Moore Die Flipper stands 5'x6'x7½' high. It will take apart and flip over a die set 20"x40" with 12" shut height, pins engaged in bushings 4".



← Counterboring for heads of screws tapped into punch flange, showing the use of ¾" chuck with long shank.

ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS JIG GRINDERS DIE FLIPPERS
PANTO-CRUSH WHEEL DRESSERS HOLE LOCATION ACCESSORIES

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

It's easy! The Perfex Radius Dresser is as simple to set as a "mike." Hardened and ground micrometer screw permits precision setting throughout the full range – from 2" convex to 2" concave. Take reading *directly* from micrometer head – *eliminate* height gauges, "mikes" and errors – *gain* simplicity, accuracy, hours of time. Simple as A B C; set your diamond to Master Setting Block furnished – then operate same as micrometer.

The Perfex Radius Dresser will dress concave radii smaller than .050" – *full 180°*. Dressing head is graduated each *5°*, equipped with stop dogs to permit dressing within given arc. One revolution of mike screw moves diamond .025", providing rapid adjustment. It's a *precision* instrument, manufactured by gage makers mindful of tool-makers' requirements. Durable carrying case with Master Setting Gage and provision for our standard diamond tool and attachment for small concave radii.

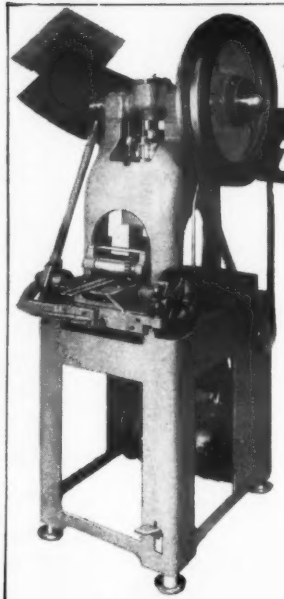
Write for details in our new folder and name of Perfex representative in your industrial center.

★ ★ ★ ★

Perfex GAGE AND TOOL CO.
123 AVERY STREET • MT. CLEMENS, MICH.

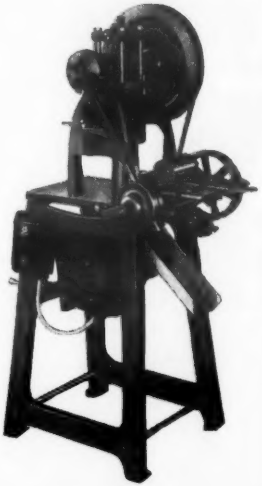
SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

DIEBEL HI-SPEED AUTOMATIC PRESSES



12 TON PRESS
65-300 STROKES
PER MINUTE

5 TON PRESS
180-550 STROKES
PER MINUTE



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SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

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One R and L Combination Turning Tool, the only combination right hand and left hand tool on the market, actually does the work of 14 tools.

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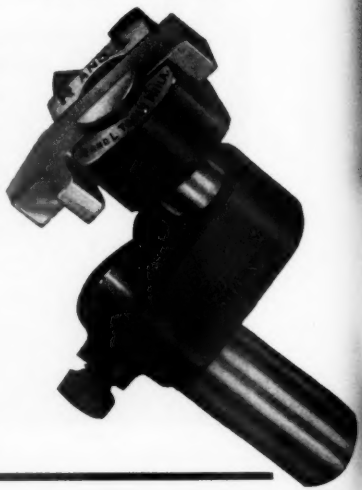

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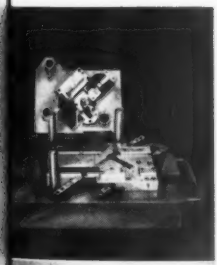

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These are the stiff necks of production that the Barth organization has cured for a wide variety of industrial firms.

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If your plant is suffering from a stiff neck that could be cured with a special machine or with a better tooling job, Barth's wide and varied experience in streamlining tool, die and special machinery production may be the answer to your problem. A consultation will not obligate you in any way. Write for the Barth catalogue.

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for

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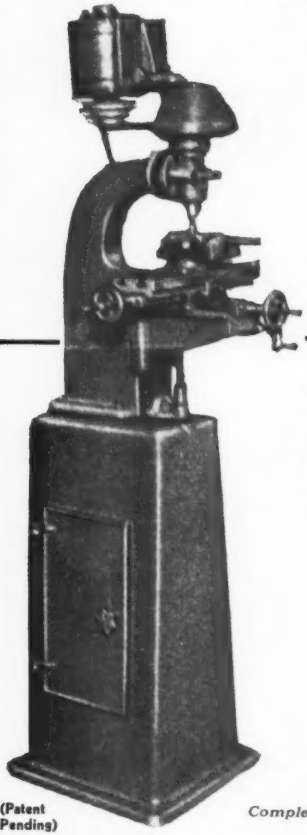

(Patent Pending)

This new vertical milling machine has been developed after five years of active production testing. The outstanding achievement of the Columbia Vertical Milling Machine lies in its ability to handle precision tool and die work which formerly was entrusted only to heavier, larger, more costly equipment.

Features include:

- ★ Rigid, heavy box-type construction.
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Here is a most versatile machine that will enable you to accomplish fast, efficient production at minimum cost. Quick set-up time and ease of operation give you HIGHER PRECISION work at LOWER COST.

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PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

production incentives

No one with an intimate working knowledge of what makes this country tick industrially can question the validity and workability of the premise that increased production and more efficient production result in material benefits otherwise unattainable.

Like any other idea of industry-wide or nation-wide magnitude, it takes constant selling to put it over; selling and demonstrating.

The selling program may be widespread and general, but the demonstration has to be specific. It has to prove to the industrial worker that any increased accomplishment on his part today will show up in his pay envelope tomorrow.

One of the most direct "point of sale" demonstrations to the worker, that increased, more efficient production can result in increased earnings, is a fair and workable plan whereby his compensation, over and above a base pay, is a measure of the extra production effort and economies that can be effected by him, his machine, his co-workers, his department and plant.

Admittedly, such plans are not of easy attainment or of universal application. That there have been many, of various labels, merits and abuses, come and gone, and that a few have "proved out" and are working to the mutual benefit of labor and management, only serve as a constant incentive for each labor and management group to strive to work out its own.

As labor and management succeed in working toward mutually profitable ways and means of increasing production, lowering costs, decreasing waste of effort and material, the way is paved for new methods, new machines and new tooling.

A new plan, devised by management consultant Allen W. Rucker and termed Share-of-Production, is of great promise because of the success which it has enjoyed in several plants to date.

It is based on the dollar value that the workers' efforts add to the incoming material as it is processed in the plant for resale. Their remuneration includes a percentage of the increased value the material receives while in their hands, hence it comes before management's profits.

As thus set up, Rucker's plan provides "take-home incentive" for the workers to increase production ways and means and efficiencies, to effect labor savings and to eliminate waste. Management, having to "make do" with what is left for its profits, is provided with an equally strong incentive toward the highest in managerial efficiency.

In common with the incentives of both labor and management are the production economies and investment returns that result from new machines and new tooling.

We can expect to hear of further and more widespread applications of the Rucker plan.

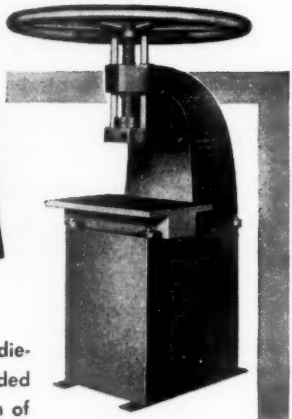
E. Willard Pennington

editor

GENERAL NO. 7

DIEMAKER'S *Tryout Press*

TRY OUT DIES IN THE DIE ROOM *ELIMINATE* TIE-UP OF PRODUCTION PRESS



A dual purpose press especially for the diemaker. Get as many try out pieces as needed without leaving the die room. Combination of the heavy, large diameter wheel with high lead thread on the ram permits safe movement of punch in and out of die at 1.6" per revolution.

This combination delivers up to 60,000 pounds percussion pressure for test pieces after die is complete.

Eliminates tie-up of production presses—saves costly time of diemaker and production press—avoids risk of injury to diemaker or damage to the die. It will prove its worth—write for literature and quotation.

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PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

Practicing What We Preach

With so much Quality Control information coming from the Federal Products Corporation via literature, the lecture platform and conferences, it is natural that the question should come up occasionally: "Do they — Federal — practice what they preach?" In other words, might the workers at Federal's Providence plant be in the position, perhaps, of the proverbial shoemaker's children? — no shoes! We put the question to Mr. Kennedy and he said that his answer would show that the Federal organization is not in the least like the old-time preacher who drank whiskey but who exhorted his congregation to do as he said and not as he did. Ed.

Convinced, from using them, of the value of systematic methods in the control of quality, including the statistical techniques, the Federal Products Corporation of Providence, R. I., undertook, a year or so ago, a program designed to spread information on what is now popularly known as Quality Control.

by Clifford W. Kennedy
Quality Control Engineer
Federal Products Corporation
Providence, R. I.

As a first step, Federal published a booklet titled: Dimensional Quality Control Primer. In a matter of two years about sixty thousand of these Primers have been sent to industries, schools and colleges, to Quality Control societies and to individuals. Evidently the attempt to describe a statistical technique in shop man's language succeeded.*

As a result of the interest stimulated in Quality Control by the Primer, or perhaps because of it, Federal has responded to a steady and continuing flow of inquiries for specific information on Quality Control applications. Speakers have also been furnished for technical society meetings, foremen's clubs and similar gatherings.

Also about two years ago, a cooperative plan arranged between Federal Products, New York University and the Massachusetts Institute of Technology, with the Norton Company, Sylvania Electric Products, Pratt and Whitney, General Electric, U. S. Time, Inc., and several other concerns, produced what are now more or less nationally known as the Federal Products Quality Control Conferences.

Six or seven of these week-long conferences have been held each year, usually about two months apart, at the Federal Providence plant. Specialists from the cooperating organizations serve as instructors, lecturers or chairmen of the conference sessions. The attendance has averaged forty industry representatives at a time, coming in from such widespread points as Maine, Iowa, Minnesota and Tennessee and from all the states between. Up to date, 250 companies have sent 410 men to these conferences.

**The Federal Products Primer covers one statistical quality control technique. The Primer has been enlarged by the author of this article into an elementary book covering the other general divisions of statistical quality control: QUALITY CONTROL METHODS, by C. W. Kennedy, Prentice-Hall, New York, 1948.*

About every known or published statistical quality control technique has been at least tried out or tested at Federal. The list of experiments covers most of the sampling plans—single, double and sequential sampling; Army, Navy and Dodge-Romig sampling tables. Percent Defective methods are used, of course, where required. A somewhat detailed description of Average and Range methods in use at Federal appeared in the May 1948 *Tool & Die Journal* as an article titled: Quality Control the Shop Man Likes. Engineers at Federal are familiar with Frequency Distributions as well as with some of the more erudite statistical techniques and significance tests such as the Chi square formula.

Where any one, or several, of the statistical quality control plans proved practical and profitable, its use in the day-to-day manufacturing routine at Federal survived.

Because of the very nature of its products and business (thirty years devoted exclusively to the manufacturing of indicating instruments for securing linear measurements), Federal's Providence plant, in ordinary manufacturing terms, is a job shop. For that reason it has been hard ground in which to cultivate statistical quality control.

Many gages are literally custom made, and the control of quality lodges almost completely in the hands of the so-called old-time worker, plus perhaps practical and intelligent inspection. Manufacturing lots of parts for stock vary from 10 pieces to 5000. A few screw machine orders may extend over 10,000 parts. Ordinary manufacture at Federal, then, bears small resemblance to mass production. Straight line manufacturing and assembly methods are feasible only on a few items in only one or two departments.

While some of its catalogue items are manufactured in batches large enough to hold a satisfactory inventory against immediate deliveries, Federal's production control system is based mostly on stock rooms or stores in which suitable inventories for some 13,000 different parts and subassemblies are maintained.

Fig. 1. *The type of chart devised by Federal Products Corporation for the double sampling plan used in most of their manufacturing operations, as well as for incoming acceptance of vendors' items.*

Batch Size →	50–100	101–200	201–500	501–1000	1000–5000	5000–10,000	Over 10,000
Take 1st sample of →	20	25	40	60	125	200	300
If defects in 1st sample are equal to or less than → accept lot	0	0	1	2	3	6	8
If defects in 1st sample exceed → reject lot	2	3	5	6	10	16	20
If defects in 1st sample are → take 2nd sample	1	1 or 2	2 to 4	3 to 5	4 to 9	7 to 15	9 to 19
2nd sample size →	20	30	80	110	185	300	400
If defects in 2nd sample ADDED to defects in 1st sample are less than → accept lot	2	3	5	6	10	16	20
If defects in 2nd sample added to defects in 1st sample equal or exceed → reject lot	2	3	5	6	10	16	20

Assembly departments draw from these inventories to meet constantly changing situations in daily orders involving a considerable diversity in indicators and indicating gages.

Hence, the hub of Federal's quality control system is batch or lot acceptance. Whether the order is for 5 or 5000 pieces, it must pass the toll gate of inspection on its way to stores. Statistical sampling schemes are used almost exclusively at these batch inspection centers.

The double sampling plan illustrated in Figure 1 is used to test most all ordinary manufacture, as well as for incoming acceptance of vendors' goods. A few items are considered more critical (purchased sapphire jewel bearings, for example, or gears and gear assemblies produced in Federal's own gear department). For such, a sequential sampling table like that shown in Figure 2 is applied.

An inspection station should do more than simply check the condition of goods flowing through. It should serve as a guide and help to operating departments. As an example of the sort of control implied, Figure 3 pictures an inspection station in Federal's screw machine department.

Fig. 3. The inspection station should serve as a guide to the operating department. In Federal's screw machine department, work from each machine is routed to the inspection station where it is sampled in accordance with the table shown in Figure 1.

Figure 2

Lot Size	Sample Size	Combined Sample		Accept	Reject
	14	14	1st	*	2
42	14	28	2nd	*	2
	14	42	3rd	0	2
to	14	56	4th	0	2
	14	70	5th	1	3
499	14	84	6th	2	4
	14	98	7th	3	4
	20	20	1st	*	2
500	20	40	2nd	*	2
	20	60	3rd	*	2
to	20	80	4th	0	2
	20	100	5th	0	2
999	20	120	6th	0	2
	20	140	7th	2	3
	30	30	1st	*	2
1000	30	60	2nd	*	2
	30	90	3rd	0	2
to	30	120	4th	0	2
	30	150	5th	1	3
1999	30	180	6th	1	3
	30	210	7th	2	3
	50	50	1st	*	2
2000	50	100	2nd	0	2
	50	150	3rd	0	3
to	50	200	4th	1	3
	50	250	5th	2	4
3999	50	300	6th	2	4
	50	350	7th	2	4
	50	400	8th	3	4
	75	75	1st	*	2
4000	75	150	2nd	0	3
	75	225	3rd	0	3
or	75	300	4th	1	4
	75	375	5th	2	5
over	75	450	6th	2	5
	75	525	7th	4	5

NOTE:
1. *The samples must be random and be taken from the entire lot.*
2. ** means, do not accept until another sample is inspected.*

Fig. 2. The sequential sampling table shown here is used on the more critical items such as gears and gear assemblies from Federal's own gear department, and vendors' jewel bearings.

Work from each machine is routed to the inspection station where it is sampled, using the table shown in Figure 1. If the work is satisfactory, it is sent on

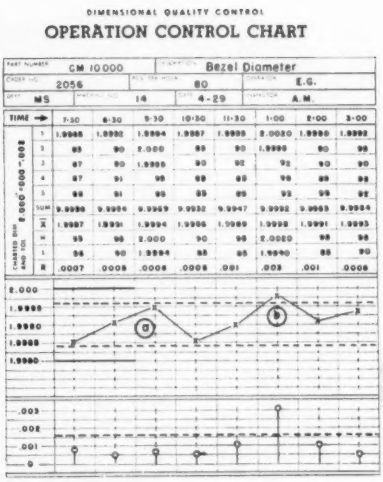

Fig. 5. The Ranges and Averages as plotted on the chart serve to prevent the manufacture of substandard work.

to stock; if not, it is returned to the operator. In the latter event, a decision is made (a) to sort or gage out the defectives, (b) rework the batch, or (c) to throw it in the scrap can.

Now, the important element in this inspection plan is timing. An effort is made to check the work from each machine as often as once every half hour. Because the inspection station is right at the screw machines, the inspector's report gets back immediately to the operator. Hence, knowing frequently how he stands, the operator is guided away from producing substandard work.

The people at Federal Products are sold on two premises. One is that defects, once made, can seldom be completely screened out in any subsequent 100% inspection or sorting. Poor work escaping the operator is bound, some of it anyway, to reach through to assembly and possibly to the customer. The other premise is that 100% inspections are basically sheer economic waste, money thrown away, and to be avoided everywhere possible. The operator has handled each piece once; why pick it up and handle it all over again? Federal believes the work should be done right the first time.

Following up this belief and theory as far as possible, a patrol inspector in another department, for example, maintains Average and Range charts at practically every machine and operation.

Fig. 4. A patrol inspector maintains Average and Range charts, Figure 5, at practically every machine and operation.

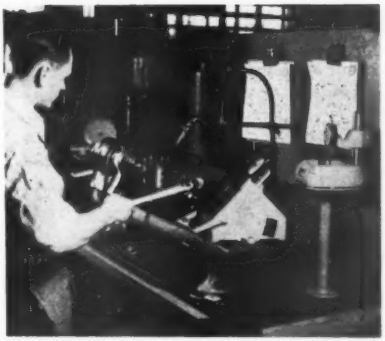

Fig. 6. The machine operator has the charts of Figure 5 to guide his work. Properly maintained, the charts give a graphic picture of both production quality level, and machine and tool condition.

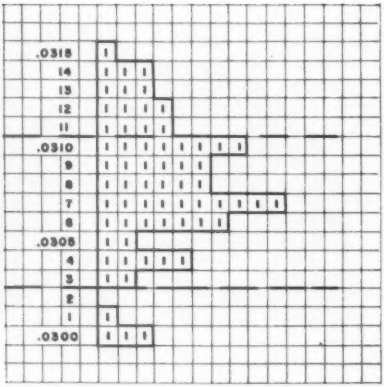

Fig. 7. The Histogram type of chart is used in investigating the accuracy-capability of machines, tooling and methods.

These charts serve to prevent the manufacture of substandard work. Figure 4 shows a chart being plotted. The type of chart used to guide the operator is illustrated in Figure 5, and a close-up of the system is pictured in Figure 6.

Technical or detailed knowledge of Average and Range charts and their control limits is not needed in order to see, in Figure 5, how the charts help. At point "a", Figure 5, the chart warned the operator to reset. If he ignored the chart, he would be bound to make out-of-tolerance work in a short while. At point "b" the chart told the operator to shut down completely, call in the tool setter and correct a condition producing definitely bad work.

In the nature of preventive therapy, another belief is followed out at Federal. Inspection stations, sampling table checks, and Quality Control charts all may serve well to guide and help the operator, but if he is facing equipment incapable of producing to the specified tolerances, all the efforts of the operator, inspection and charts combined cannot prevent the formation of defective parts.

From time to time, what might be termed the accuracy capability of existing operations—machines, tooling, methods—is investigated. Pilot lots of new products are studied and statistical analyses are used to check changes or attempted improvements in tooling, methods or the process. Special investigations probe reasons for excess run-out and taper and for lack of uniformity in, say, hardening or coloring or die life.

Frequency distributions or Histograms of the sort shown in Figure 7 are favorite tools for this quality research. The tally diagram of Figure 7 disclosed at a glance, after it was made, the inability of a certain screw machine, as it was then operating, to make parts within the required .0007" tolerance spread. A "dot" chart tally or study of run-out is illustrated in Figure 8. Frequently such graphic illustrations of operation capability are corroborated, to lapse for a second into the quality control engineer's jargon, by calculating the standard deviation, the sigma, of the variations observed and comparing the six sigma limits with the specification. Where the statistical results report unfavorably on an operation, method or machine, an effort is made, of course, to overcome the trouble. Studies of the type sketched above also lead many times to the adoption of more practical tolerances.

Like any worthwhile science, Quality Control includes analysis, prediction and then control, in that order. Sensible use of statistical techniques both from the angle of quality research and the main-

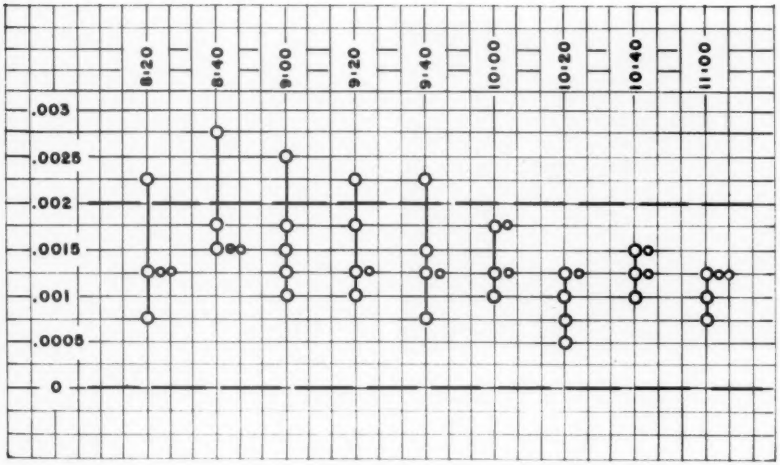

Fig. 8. A "dot" chart type of study as used to verify operation capability. It may indicate a need for more practical tolerances when the statistical results report unfavorably on an operation, method or machine.

tenance of control thereafter is paying dividends at Federal. Scrap and rework losses consistently remain under 1%, production increased up to 10% without a deliberate speed-up and the whole tone of manufacture improved after practical quality measures were adopted. Some small credit for such gains can be assigned to statistical quality control routines. And no calculation has yet been attempted of the dollars and cents earned in product reliability and eventual customer satisfaction.

Pratt & Whitney Precision Gages Control Quality of Refrigerator Parts

Precision parts are vital to hermetically-sealed, self-lubricating, self-cooling, refrigerator compressor units. The parts must fit accurately and operate over long periods without wear or noise. "Tenth" limits are specified on compressor cylinders and pistons, for diameters and roundness, and connecting rods and wrist pins are subject to equally close tolerances. Selective assembly and quality control methods are widely used.

Throughout the refrigeration industry, Pratt & Whitney Air-O-Limit, Electrolimit and Electric Contact comparators are used as working gages at the machine for quality control, as "stage" and final inspection gages for selective assembly, as laboratory basic standards for setting and correlating working gages, and in "receiving inspection" for checking vendors' parts.

Electrolimit comparators handle external and internal measurements, using electric magnification, which spreads "tenths" over broad scale divisions. Air-O-Limit comparators use compressed air for internal "tenth" measurements of size, taper, roundness and bellmouth. Electric Contact comparators, with fast-acting, leaf-type contacts, show "over" and "under" parts as fast as they can be handled. Pratt & Whitney comparators are applied to the problems of checking correctness of subassemblies and measuring the critical clearances and angles in roller-type compressors. Extensive gage engineering is essential to perfect unit performance.

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Style "A" Portelvator
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SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

QUALITY
Measuring - Testing - Inspection
CONTROL

Controlling Surface Finish to Specified Quality Standards

the WHAT—WHY and HOW

In finishing surfaces of machine parts, tools, dies, and molds, the conventional methods of machining and grinding have been supplemented by lapping operations involving the use of diamond abrasives which so speed the work that for the first time it becomes economical to take advantage of the well known service advantages of high surface finish.

It is necessary first to understand the language of surface finishes. New standards are now being developed to show numerically just what we desire in the way of finishes. The most common measurement utilizes a diamond point moving over the surface being measured. This stylus "feels" the depth of valleys and heights of peaks and by electrical means records them with ink on a graph paper. This measurement is in micro-inches (a micro-inch is one millionth of an inch) and can be either the absolute difference between the hills and valleys, or a running average.

For measurements of very fine surfaces the absolute readings are more useful because they show the surface imperfections to a higher degree of magnitude. In the fine watch field, for instance, finishes are so refined that it would be difficult to make distinctions if the absolute method were not employed. For general machine purposes, however, the surface irregularities are so large and numerous that the average readings give a good comparative story and the average reading proves more generally useful to the analyst. The average readings are indicated by the symbol "r.m.s." after the numerical micro-inch designation and are derived from the term "root-mean-square". Various surfaces produced by standard methods and indicated by r.m.s. values are shown in Figure 1.

A designation system has been set up to indicate surface undulations and imperfections of every kind so that a sur-

by Roger F. Waindle
General Manager
Industrial Products Division
Elgin National Watch Company

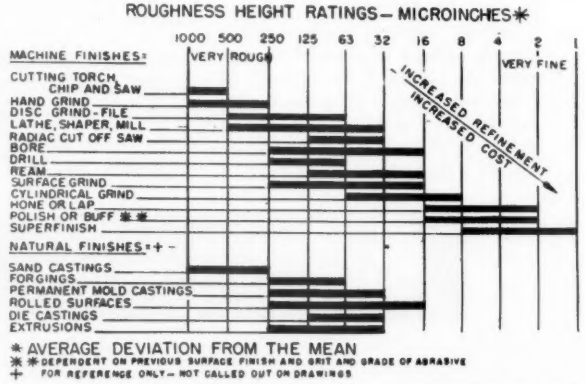


Fig. 1. A tabulation of the range of surface roughness produced by a variety of standard methods. New standards are being developed to show numerically just what is desired in the way of surface finish. The micro-inch (one millionth of an inch) ratings can be either the absolute difference between the "hills and valleys" or a running average.

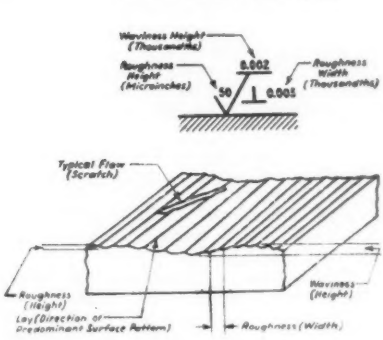


Fig. 2. Surface undulations and imperfections have to be described in terms that have a common meaning. This diagram shows the designation system that is coming into common, industry-wide, usage. This is a great advance over simply noting the hills and valleys in describing surface quality.

face finish symbol can be given to specify any surface condition as shown in Figure 2. This is highly advanced over simply noting hills and valleys and is just coming into common usage.

So much for WHAT surface finish is; the next consideration is WHY do we want better surface finishes?

Experience in the fine watch business, where actual finishes in the fractional micro-inch range are the rule rather than the exception, has shown that wear resistance is increased, close fits are maintained longer, and friction is reduced by better surface finish. As now supported by the superfinishing theory, ordinary machining operations (turning or grinding, and even harsh lapping) generate terrific heat at the immediate surface being cut.

The result is the formation of an amorphous layer of material that does not have much wear resistance in itself, is rough and irregular (see Figure 3) and initially creates higher friction because of its roughness, then breaks down and is removed from the true metal surface by abrasion, thus resulting in dimensional change or wear.

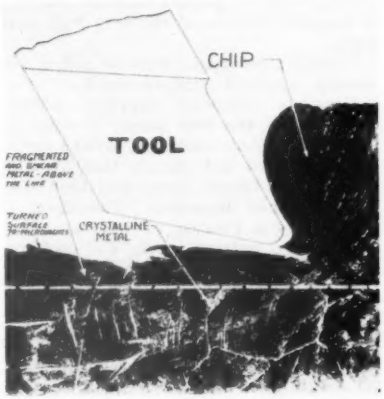
The gently abraded, or true lapped finish, has a hard, true metallic surface to present to the mating part, or to the work being cut, in the case of a tool. Also, in the latter case, where the tool is simply ground, the "feather edges" or burrs break off almost immediately on contact with the work, the breaks cause minute jagged edges which progressively break down, and tool wear is rapid.

Contrast this with a polished, yes, slightly rounded, clean metal tool edge which plows through the work with a minimum of friction (another result of high surface finish) with less heat and no progressive breakdown of that all-important cutting edge. And the economics are good; one example is from a General Electric plant where diamond lapped carbide tools now cost 1% more to finish but give 50% more service between grinds!

For plastic and die-casting molds, higher finishes mean superior finish on the molded part, longer mold life and less knock-out trouble.

Carbide and steel heading and wire dies are finished cheaper and last longer when diamond-finished. Higher finishes in press forging dies have lead to entirely new designs using tougher, softer

Fig. 3. The formation of the amorphous layer of metal on machined surface shown by actual photomicrograph. Undisturbed, wear resistant crystalline material is exposed by lapping off the amorphous layer for lower friction, longer wear life. Photomicrograph by Chrysler Corp.



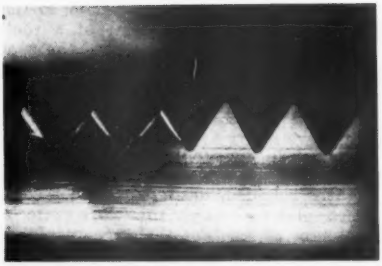


Fig. 4. Photomicrograph of 4-48 tap teeth at flute. Note typical grind burr at left. Breakdown of this burr leads to rapid tool wear and tool marks on work. Elimination in this case was by liquid honing but similar results obtained from lapping with diamond. Photo courtesy Vapor Blast Mfg. Co., Milwaukee, Wis.

alloy steels with correspondingly greater shock resistance for two to three times the service life. Highly finished deep-drawing dies wear longer, are less susceptible to poor lubrication damage and reduce inter-draw annealing requirements.

Machine parts can be fitted closer, operated with less wear and lower frictional drag when surfaces are finished to a higher degree. In marine chronometers it was found that ultra fine finishes on both the hardened steel fuzee staff and the brass bearing resulted in perfect performance. However, anything short of almost perfect finishes resulted in disaster because of the very high unit loads.

Closely sized parts such as gages are readily lap-sized with diamond.

How is diamond lapping accomplished? In the first place, it must be understood that diamond always cuts; it is so hard and tough that it cuts rather than breaks down and burnishes as will other abrasives. Therefore, it finishes by a process of microgrinding the surface, cutting freely and cool, reducing the surface irregularities so fast that, in most instances, it is cheaper to use the diamond compounds than abrasives of much less intrinsic worth.

As to "HOW": The abrasive is applied by any of the common methods, i.e., machine lap, rotary or reciprocating hand tool, or hand stick, depending on the job. Diamond abrasive, because it does not break down readily, is graded in size bands for a given job and the worker follows coarse with medium and then with fine abrasive in successive steps, carefully cleaning the work between steps.

In each case, the surface becomes uniform for that abrasive particle size and perfectly prepared to go to a higher degree of finish as produced by the next application of a smaller diamond particle size.

The Bureau of Standards has set up size grading standards for diamond that prescribe the maximum and minimum of particles in a given range. For instance, diamond designated "6 micron size" is limited to particles ranging from 4 to 8 microns across the roughly cubic shape (a micron is one one-thousandth of a millimeter, or approximately .00004") and this No. 6 powder is roughly equivalent to 3000 mesh sieve size.

It is important to understand that when using diamond abrasive, the work is done in succeeding steps, each step being followed by a smaller particle size and each particle size producing a finish characteristic of its own. For instance, on 64 Rc fine-ground, high-carbon steel worked with diamond compound on a laminated bakelite lap the following results are obtained:

Finish	Micro-inch, r.m.s.
Ground	18
#40 diamond (325 mesh)	3.1
#25 diamond (600 mesh)	1.3
#14 diamond (1200 mesh)	.42

Properly prepared abrasive compounds, that is, abrasive particles such as diamond suspended in a vehicle which lubricates, spreads, cools and wets the work-surface, are surprisingly effective, reducing time and permitting repeatable, predictable results so that surface finishing operations may be time studied and intelligently controlled.

A good illustration of the economy possible by using prepared abrasive compounds is that of our own Sapphire parts manufacturing operations. In the making of pallet stones it was found about three years ago (yes, we were all getting more economy minded about

Diamond Powder Applications and Identification

General Recommendations	Diamond Powder			Diamond Concentration in Compound	Identification	
	Grade (National B of S Equiv.)	Micron Size Range	Mesh Size Equiv. Average		Compound Color	Compound Number
Finest metallographic polish.	¼	0–½	60,000	Medium	¼-W-475	Grey
Finest polish on Steel. Metallographic polish on Carbides.	1	0–2	14,000	Light Medium Heavy	1-W-48 1-W-47 1-W-45	Light Blue Medium Blue Deep Blue
Finest polish on Carbides, Sapphire.	3	1–5	8,000	Light Medium Heavy	3-W-45 3-W-40 3-W-35	Light Green Medium Green Deep Green
Good polish on Steel. Sapphire. Best "general purpose" polishing.	6	4–8	3,000	Light Medium Heavy	6-W-42 6-W-375 6-W-30	Light Yellow Medium Yellow Deep Yellow
Medium polish on Carbides and Sapphire. Removal of lines and pre-polish on Steel.	8	6–10	1,800	Light Medium Heavy	8-W-40 8-W-35 8-W-30	Light Red Medium Red Deep Red
Fast lapping on Steel; pre-polish on Carbides.	14	8–20	1,200	Light Medium Heavy	14-W-40 14-W-30 14-W-20	Light Brown Deep Brown Dark Brown
Rapid stock removal with good finish on Steel. Good stock removal on Carbides.	25	13–37	600	Light Medium Heavy	25-W-40 25-W-30 25-W-20	Light Mahogany Deep Mahogany Dark Mahogany
Fastest stock removal. Removes deep scratches, waves and nicks.	40	20–60	325	Light Medium Heavy	40-W-40 40-W-30 40-W-20	Light Purple Deep Purple Dark Purple

Diamond abrasive, because it does not break down readily, is graded in size bands for a given job. The user follows coarse with medium and then with fine abrasive in successive steps, carefully cleaning the work between steps. In each case, the surface becomes uniform for that abrasive particle size and perfectly prepared to go to a higher degree of finish as produced by application of the next smaller diamond particle size.

then) that the cost of diamond used in the manufacture of these parts was averaging 1.9¢ per finished stone. By designing engineered compounds and applying them intelligently, this cost came down to an average of 0.2¢ per stone and has stayed that way ever since. What did the new compound do that wasn't done before? It separated the abrasive particles so they did not work on each other; it brought lap and work closer together so the abrasive could work better and it provided a hitherto lacking performance uniformity that enabled operator and methods engineer to work out more efficient usage, thus resulting in higher earnings for worker and company.

This study indicated that much former diamond consumption was due to loss and wastage of loose diamond powder on the job, which was eliminated by the prepared compound and sure-fire method of dispensing.

The result has been the development of a series of engineered diamond compounds. All compounds are colored to show immediately the abrasive particle size. They are enclosed in glass cartridge tubes and are used in a piston-type gun so that contamination is eliminated and application is made exactly at point required.

Having thus removed most of the variables, a new and very important variable has deliberately been added to the system to compensate for peculiar characteristics of each type of job. Where faster cutting action is required, or where the material being cut is harder (carbides versus steel, for instance), a heavier diamond concentration is sometimes recommended. Accordingly, the perfected diamond compound was next prepared with three different diamond concentrations: heavy, medium and light, to permit the engineers to work out the most efficient cost per unit of stock removal.

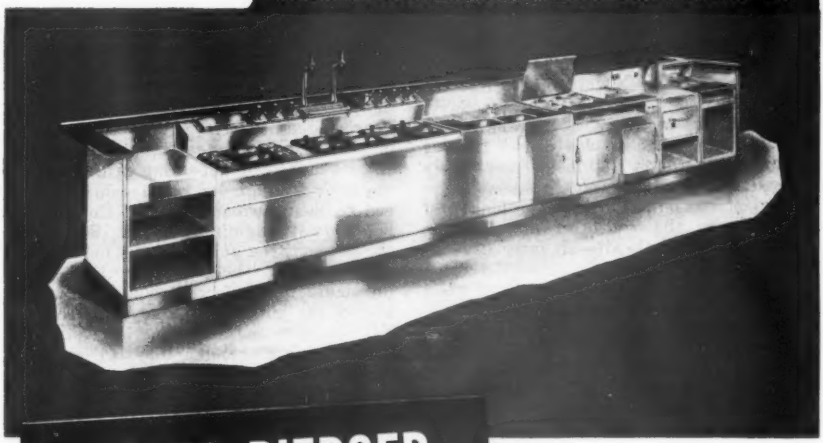
A system of designation for the No. 6 diamond, mentioned above, became 6-40 (light), 6-375 (medium), and 6-30 (heavy). Then, since the composition of the carrying vehicle could be made either water- or oil-soluble, a letter to indicate this was added to give us a final designation, i.e., 6-W-375 for Bureau of Standards No. 6 diamond in water-soluble vehicle with medium diamond concentration. The full diamond abrasive compound system is detailed in the accompanying table.

Fig. 5. Showing use of the gun-type diamond compound applicator in charging laminated bakelite lap. Compound is loaded into gun in sealed cartridge, is color identified and contamination proof yet immediately available at all times.

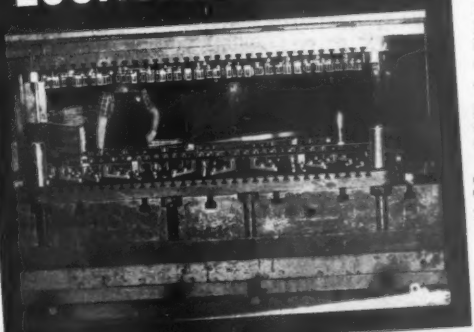
The day of acceptance of commonly machined surfaces is waning. New knowledge of the advantages of good surface finishes and simplified methods of obtaining micro-finishes forecast both higher production for tools and dies; and longer life in machine parts.

Fig. 6. Polishing a plastic mold die using a conventional hand grinder with felt bob. Such operations with diamond compounds are alternated with hand sticks to follow irregular contours. Photo courtesy Precise Products Co., Racine, Wis.

INCREASING PRODUCTION EFFICIENCY WITH WHISTLER ADJUSTABLE DIES



HOLES PIERCED SIMPLE, FAST AND ECONOMICAL...



PIERCING operations necessary in producing a 22' Fountain layout are no problem when Whistler Adjustable Dies are used. Set-ups for perforating, notching, slotting and rounding take less time. Precision is assurd on long and short runs. Changes can be made without tying up press production.

The real savings are in the continued reuse of the same dies on different jobs. Punch and die units can be rearranged. New sizes or shapes can be added. The heavy duty units easily pierce materials up to and including ¼" mild steel.

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SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

QUALITY
Measuring - Testing - Inspection
CONTROL

Gage Control

Measuring tools of the early craftsmen were no more refined than were their other tools, but structures like the 4000-year-old pyramids bear adequate proof that methods of measurement have long been in existence. History tells us that for the most part, early standards of linear measurement were parts of the human body. The length of a forearm, the width of a palm, the width of a thumbnail—all were used as gages.

by W. D. Angst
Methods Engineer
Staff Industrial Engineering Dept.
Thompson Products, Inc.
Cleveland, Ohio

Modern interchangeability would be inconceivable with such crude units as those mentioned. Eli Whitney, who is generally regarded as the father of interchangeable manufacture in the United States, used his own set of standards to make guns, the components of which could be used interchangeably, but no independent shop could be assured that its parts would fit together with parts from another shop.

In 1866, an Act of Congress legally authorized the meter as the standard of length. Although the meter is still defined in some Physics classes as "the distance between two scratches", it does bear a definite relationship to the circumference of the earth, and could be re-established by repeating original surveys; or through its relationship to the red radiation wave length of the metallic element Cadmium. From 1866 until the present, the ability of the measuring instruments to keep pace with the refinements in production equipment regulated the growth and development of our present mass production and its inherent interchangeability throughout industry.

With the high production, high precision, types of machine tools now employed by industry, greater numbers of gages are required. It is not an uncommon occurrence to find the gaging equipment, Figure 1, for a given operation in a modern production shop exceeding the complexity of the machine's tooling on that operation. The advent of statistical quality control in recent years has added new concepts of precision and measurement, leading to more and finer gaging facilities. This widespread use of complex measuring tools has made it imperative that gage control be included as an integral part of a large manufacturing organization.

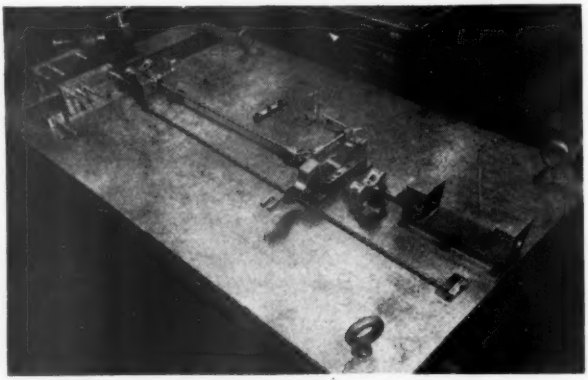


Fig. 1. Concentricity gage for turbine wheel and shaft. The advent of statistical quality control in recent years has added new concepts of precision and measurement, leading to more and finer gaging facilities. The widespread use of such complex measuring tools has made it imperative that gage control be included as an integral part of large manufacturing organizations.

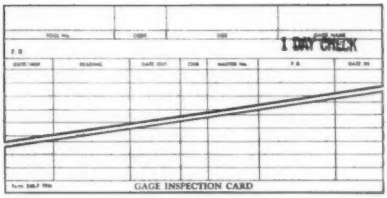


Fig. 2. Gage Inspection Card.

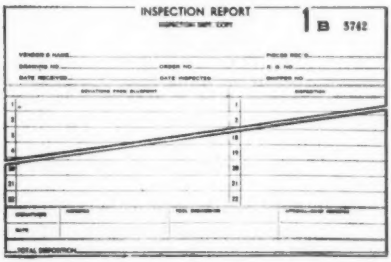
In an effort to meet the demands of the present gaging problems, Thompson Products, Inc., has developed several media for their control. This article describes the application of gage control techniques in the Tapco plant, the company's largest manufacturing unit of precision parts.

Procedures

The organization and policy of all gage control facilities have been made the responsibility of the Quality Manager who reports directly to the Chief Engineer. All practices, equipment, and personnel relative to the control of gages are under the jurisdiction of the Quality Manager.

To insure coordination of, and to establish policies for, the gaging facilities, the Quality Manager has issued Procedures covering all phases of gage control from the time of the gage's receipt through its acceptance, distribution, use and final disposition. These Procedures are as comprehensive as is practical, indicating applicable records, tolerances, wear allowances, checking schedules, etc., and serve as a framework for the organization and operation of all gage control.

Fig. 3. Tool and Gage Inspection Report.



Incidentally, these Procedures are in conformance with federal and aircraft specifications applicable to the products made within the Tapco Division, and have been extremely valuable in maintaining gage control at a level consistent with Air Force regulations governing the manufacture of aircraft engine parts.

Acceptance of Gages

Gage control practice begins when a gage reaches the Tool Inspection Dept., either from the plant tool room or from outside vendors. The gages used on any given operation are specified, along with the other tooling, on the operation sketches as issued by the Planning Engineers. Standard gages are called for wherever possible. Where special gaging is required, the Gage Designers draw up the necessary equipment. All tooling is then ordered sufficiently in advance to be available when the job is released to the Production Department.

At the time the order is placed for gages, a Gage Inspection Card, Figure 2, is made out and placed on file in the proper gage crib as a permanent record. A Gage Inspection Card is made out for each gage. When the gage is completed, the gage and the card are given to the Tool Inspection Department for their inspection and disposition.

Gages are checked by the Tool Inspection Department against the tooling print and the parts drawing for basic inspection points. They are also checked for functioning and for workmanship before acceptance for production or inspection use. The results of the inspection are recorded on the Inspection Report, Figure 3. Here again, a separate report is made out for each gage except when several identical gages are inspected together. In such a case, all the identical gages would be reported on the same form.

Any gage which has a discrepancy is reviewed by the Tool Engineering Department in conjunction with a member of the Quality Manager's group. Together, they decide whether the gage is

TOOL TICKET

Tool No. _____

F.R. No. _____

Oper No. _____

Mach. No. _____

Date _____

Dept. No. _____

Master No. _____

Signature _____

FORM 346-S

Fig. 4. Tool or Gage Request Ticket.

to be accepted as is, or accepted for trial and approval, or rejected to be reworked. Accepted gages are sent to the Gage Crib along with the Gage Inspection Card which has been marked to show the exact measurement of the gaging dimension. The Gage Inspection Card is put on file in the Gage Crib and the gage is placed in a suitable container or rack where it will be properly protected from damage or dirt until it is issued to either the Inspection or Production Departments for use.

Each gage is assigned a part or assembly number by which it is identified for the length of its life. In no case is the same number assigned to any other material. In case several gages of one design and size are used, each gage is identified with the same number, plus a letter after the number. Ordinarily, the number of identical gages is well within the range of the alphabet.

Distribution

When a gage is required from the Gage Crib, a Tool Ticket, Figure 4, is filled out by the employee and given to the Gage Crib attendant who keeps such

Fig. 5. Gage Size Chart.

GAUGE SIZE CHART

GAUGE NO. _____

SHIFT	DATE	TIME	HIGH LIMIT	LOW LIMIT	CHECKER'S NAME	REMARKS

cards on record in order that the gage can easily be traced if it necessitates recalling. When the gage is issued to the employee, the Gage Size Card, Figure 5, will accompany the gage indicating the exact measurement of the gaging dimension as noted on the Gage Inspection Card. On the upper right-hand corner of the Size Card is marked the maximum interval of time or the frequency of usage to elapse before the gage is to be returned to the Gage Crib for reinspection. The time of issuance and the date are also placed on the card.

Several different colored Gage Size Cards are used to denote the various inspection intervals. A *white* card is used for those gages which are to be checked within eight hours or less; a *yellow* card for those gages to be checked within one day; and a *green* card for all gages having an inspection interval of more than one day.

Reinspection Schedule

The inspection interval for gages in use has been tabulated from data obtained through actual experiences. A typical example is shown in Figure 6. All gages have been typed into four categories, viz., plug and ring, snap, thread, and special gages. Each category is subdivided into time intervals, generally proportional to the tolerance of the gaging dimension. The time intervals are sometimes further divided according to the material of the gaged part; either ferrous or non-ferrous, or other specifically applicable conditions.

In the case of thread gages, the term "uses", Figure 6, is to indicate the number of holes on internally threaded members and the number of pieces on externally threaded members on which that gage is used. The relatively tight control of thread gages for "ferrous material" as shown in Figure 6 is a temporary condition resulting from very critical thread gaging problems in special alloy steels. New gage materials and techniques are being studied to reduce the high frequency of gage inspection.

Fixture gages, which include special setting masters for adjustments, require no checking after they have once been

PERIODIC INSPECTION SCHEDULE

Type of Gage			Time Interval	
			Ferrous Material	Non-Ferrous Material
Plain plugs and ring gages				
Full tolerance	(1)	.0000-.0010	8 Hours	8 Hours
	(2)	.0011-.0020	1 Day	1 Day
	(3)	.0021-.0050	7 Days	7 Days
	(4)	.0051-.0100	14 Days	14 Days
	(5)	.0101-up	30 Days	30 Days
Standard and special snap gages				
Full tolerance	(1)	.0000-.0010	8 Hours	8 Hours
	(2)	.0011-.0020	1 Day	1 Day
	(3)	.0021-.0050	7 Days	7 Days
	(4)	.0051 and up	30 Days	30 Days
Thread gages—snap, roll ring and plug				
Class	(1)	Special	25 Uses*	8 Hours
	(2)	4	"	1 Day
	(3)	3	"	1 Day
	(4)	2	"	3 Days
	(5)	Standard	"	7 Days
	(6)	Pipe	1 Day	7 Days
Special gages				
	(1)	Spline	1 Month	1 Month
	(2)	Flush pin	4 Months	4 Months
	(3)	Template	6 Months	6 Months
	(4)	Location gage	6 Months	6 Months
	(5)	Fixtures	6 Months	6 Months

*Temporary.

Fig. 6. Typical Inspection Interval Chart.

accepted, as long as the master remains within tolerance. Masters are checked within specified periods.

The period shown in the table is the actual time that has elapsed since the gage has been put into use. Should a gage be issued and the scheduled time period elapse before the gage has been put in use, it is not necessary to submit this gage for reinspection. However, should this condition arise, it should be noted on the Gage Size Card by the inspector involved, giving all the pertinent dates.

The Inspection foreman is responsible for seeing that all gages are submitted to the Gage Crib as scheduled for checking. The Gage Cribs have the responsibility of seeing that the gages' inspection operations are performed and that the Gage Inspection Card is correctly marked after each transaction. In addition, the Gage Cribs assist the Inspection foreman by keeping him informed as to which gages in his group are to be checked each day.

Reinspection of Gages

The reinspection of gages is generally done by the Tool Inspection Department. Some standard gages are reinspected by the Gage Crib personnel but the procedure is the same. The gages to be checked are delivered to the Tool Inspection Department along with the Gage Inspection Cards. The gages are checked and the gaging dimensions and dates are noted on the cards. As in the case of new gages, the reinspected gages are either accepted as being correct, or are submitted to Tool Engineering and the Quality Manager for disposition. Accepted gages are returned

RANGE AND TOLERANCE CHART

Nominal Dimension		Male Gages Only	Tolerances			Ring Gages Only
Above	To and Incl.	XX	X	Y	Z	ZZ
.029	.825	.00002	.00004	.00007	.00010	.0020
.825	1.510	.00003	.00006	.00009	.00012	.00024
1.510	2.510	.00004	.00008	.00012	.00016	.00032
2.510	4.510	.00005	.00010	.00015	.00020	.00040
4.510	6.510	.000065	.00013	.00019	.00025	.00050
6.510	9.010	.00008	.00016	.00024	.00032	.00064
9.010	12.010	.00010	.00020	.00030	.00040	.00080

Fig. 7. Gage Range and Tolerance Chart.

to the Gage Cribs accompanied by their Gage Inspection Cards. No gages are ever reissued until the reinspection operation has been accomplished.

Wherever practical, an inventory of each type of gage is maintained so that acceptable gages are always available at the cribs.

Tolerances

The Range and Tolerance Chart, Figure 7, shows the tolerances for the various classifications of gages. These tolerances have been accepted as standard on all width, height, depth and length gages. Unless otherwise specified on the blueprint, all gages are manufactured to the "X" gage tolerance. Where a finer or closer tolerance is required, the blueprint definitely calls for the desired gage tolerance classification. In general, on the "go" member of all gages the tolerance is held on the plus side of the nominal dimension, and on the "no-go" members the tolerance is equally divided on the plus and minus sides of the nominal dimensions. Ring gages are held on the minus side on both the "go" and "no-go" members, unless otherwise specified.

A similar chart for "X" classification thread gages is used to standardize the tolerances for thread gages. This chart includes tolerances on lead, angles, major and minor diameters, and pitch diameter for all applicable thread sizes. On all thread plug gages, the tolerances which are given in the chart for the pitch diameter are on the plus side on the "go" members and are on the minus side on the "no-go" members. On all thread ring gages, the tolerances which are shown on the pitch diameter are on the minus side on the "go" members and on the plus side on the "no-go" members.

Wear Allowance

In general, all gages must be within the blueprint limits to be acceptable for distribution from the Gage Cribs. However, in the cases of plug and ring gages, and thread gages, allowance for wear has been accepted as described herein.

On the "no-go" member of a plug gage, one half of the tolerance called for in the Range and Tolerance Chart may be added to the minus side of the nominal dimension. The plus side must be within the total tolerance limit. For example, a .750" diameter plug made to the "X" tolerance shows a range of .00004". This tolerance is to be divided equally on both sides of the nominal dimension (.750" plus .00002", minus .00002"). In addition to this tolerance, on the minus side we add one half of the .00002" (.00001"), giving us a total of .00003". The full tolerance of .00004" is used on the plus side.

On the "go" end of a plug gage, the full tolerance as called for in the Range and Tolerance Chart may be used on the

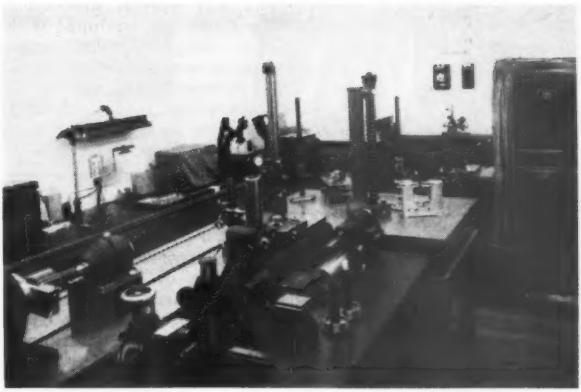


Fig. 8. A temperature-controlled room, Tool Inspection Department, Thompson Products, Inc. This houses the more sensitive gages for inspecting the high precision tools and working gages. Readily recognizable is such master equipment as: Vinco Optical Dividing Head, Bausch & Lomb Optical Projector, Pratt & Whitney Super Micrometers, Pratt & Whitney Measuring Machines, Cadillac Gage Company's "Pla-Chek", and a Gaertner Tool Makers' Microscope.

plus side. The minus side carries a maximum of .00002" in all cases. Therefore, a .750" "go" member plug gage has a wear limit of plus .00004" and minus .00002".

Ring gages have an equal wear allowance for both the "go" and the "no-go" members. The full tolerance for a particular diameter as called for on the Range and Tolerance Chart may be used on the minus side of the nominal dimension. The plus side carries a maximum of .00002" in all cases. Thus, a .750" ring gage made to the "X" tolerance will have a wear allowance of minus .00004" and plus .00002".

Wear allowance on thread gages is governed by the "Y" classification tolerances chart. Therefore, thread gages, manufactured to "X" tolerances, are acceptable as long as they do not wear beyond the "Y" tolerances.

Another minor exception to absolute adherence of gages to the blueprint tolerances is the case of setting masters in conjunction with dial gages. It is permissible to use setting masters within .001" of the high or low limit for the particular dimension to be measured. For example, a setting master for a dimension of .872 – .878" could be anywhere in the range from .871" to .879".

The problem of using wider tolerances than the usual "X" standards for rough or open gaging dimensions has frequently arisen. Gage scrap could be materially reduced by using gages worn beyond the given allowances, for the rough dimensions. The difficulty would be in preventing these "off-tolerance" gages from being used erroneously on finish dimensions. To date, no satisfactory method of segregating like gages with varying tolerances has been offered which is consistent with required quality standards.

Gage Control Facilities

TOOL INSPECTION. The facilities for effecting gage control are made up basically of the Tool Inspection Department, the Gage Cribs, and adequate personnel for their smooth operation.

The Tool Inspection Department includes some of the finest measuring equipment. A controlled-temperature room is provided, Figure 8, for housing the more sensitive gages and for inspecting the high precision tools and gages. A partial list of the equipment includes such items as: Vinco Optical Dividing Head, Bausch & Lomb Optical Projector, Pratt & Whitney Super Micrometers, Pratt & Whitney Measuring Machines, and a Gaertner Tool Makers' Microscope.

The Tool Inspection personnel is divided into three classes, dependent upon the degree of skill required for the particular work done.

A recognized first-class Tool and Gage Inspector is required to inspect a wide variety of tools, jigs, fixtures, dies and

Fig. 9. Mobile Gage Inspection Units are equipped to service gages right at machine.

gages prior to their use, to make certain the dimensions and quality are within acceptable tolerances. He is required to work from highly complex drawings and specifications and with all types of precision measuring and testing equipment to determine the acceptability of the work submitted for inspection.

A second-class Tool and Gage Inspector is required to do work similar to that of the first-class man within a limited variety and with some assistance from employees of higher skill.

A third-class Tool and Gage Inspector checks only the relatively simple tools and gages and usually only those which are somewhat repetitive. Magnaflux and hardness testing is also required of the third-class men.

The ratio of the number of employees of each classification is approximately equal.

GAGE CRIBS. The Gage Cribs are basically storage and distribution centers for the production gaging equipment. In addition, the Gage Cribs provide means for setting adjustable gages, making original readings on first production pieces, making temporary inspection setups, and assisting the Manufacturing Department in any special measuring problems. The Cribs are equipped with surface plates, height gages, gage blocks, super micrometers, surface analyzers, visual comparators, and other comparable measuring tools necessary to perform routine gage setting and special inspections.

Operating out of the Gage Cribs, mobile inspection units, Figure 9, are able to service gages right at the machines. These gage wagons are equipped to check most of the standard gages and to set the majority of the adjustable gages. The wagons carry the same records as would be maintained in the Gage Cribs and by following predetermined routes through a manufacturing area, all gages in that area may be checked at the required intervals. By bringing the gage checking equipment to the gages on a prescribed schedule, tremendous reductions in lost time and inspection errors have been possible. The value of these wagons has been especially apparent in the automotive valve department where large volume line production is employed.

The Gage Crib personnel also is divided into three classifications dependent upon skill.

A first-class Gage Setter must perform adjustments and settings on all types of gages used in normal production work. He must be able to use all the available equipment as required by his duties of making temporary inspection setups and measuring initial production pieces.

A second-class Gage Setter is required to do similar work with a lesser degree of skill. The second-class man is usually assigned to the mobile inspection units.

A third-class Gage Setter is responsible for the routine and more simple work relative to the Gage Crib's functions. He does most of the record keeping and follow-up on reinspection intervals and usually requires considerable supervision and help from the higher skilled employees.

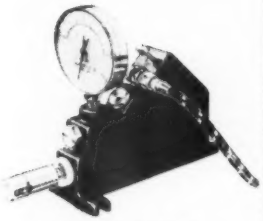
A somewhat independent branch of the Gage Cribs is the Gage Repair Group. This group of about four men serves to repair and maintain special-

(CONTINUED ON PAGE 84)

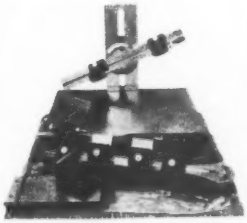
Look to Merz

for precision equipment for every inspection need!

EXACTITUDE
STANDARD A.G.D. GAGES



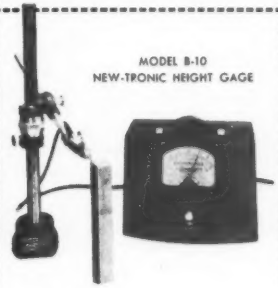
VERSATILE—MODEL 30
NEW-MATIC MEASURING MACHINE



MASTER MODEL
UNIVERSAL CHECKING PLATE

MODEL A
NEW-TRONIC
BALL SORTER

MODEL A-10
NEW-TRONIC
COMPARATOR



MODEL B-10
NEW-TRONIC HEIGHT GAGE

VIGILANT—MODEL 60
NEW-MATIC
MEASURING MACHINE

Whatever your inspection requirements, look with complete confidence to Merz precision measuring and checking machines. Every Merz product is a proved cost-cutter, a tested time-saver. The Merz line includes *New-Matic* Measuring Machines, *New-Tronic* Comparators and Gages, Checking Plates, Standard A.G.D. Gages. Merz also specializes in the custom-building of equipment for handling unusual inspection and sorting problems, however complex. Merz inspection equipment has for years been helping to reduce loss, speed production and increase profits for many of the nation's leading industries. Write for complete information on how Merz' "Four Spheres of Service" can do the same for you.

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MERZ

The House That Precision Built

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

QUALITY
Measuring - Testing - Inspection
CONTROL

Quality Control at Jack & Heintz

Inspection at Jack & Heintz Precision Industries, Inc., as in many companies, is divided into two types: patrol inspection and station inspection. In the Ball Bearing Division, these two types of inspection have been systematized along a simplified Statistical Quality Control basis which has produced amazing results both in quality and economy. A comparison of before and after the installation of this system at Jack & Heintz discloses the following:

	Before Quality Control	After Quality Control
% of Inspection Personnel to Production Personnel	25%	15.5%
% of Sales Dollar for Inspection	8.85%	5.0%

This amounts to a saving of $76,000.00 per year in inspection. All of this saving has been accomplished with an advance in quality and additional unmeasurable savings, such as easier inspection, administration, work passing through inspection faster, closer control of quality, more coherent quality reports and increased quality consciousness of operators.

The entire system is based upon the thinking that production is solely responsible for quality and inspection is conducted for the purpose of *accepting* material and passing information on quality back to production. It is felt that an inspection department has an abundance of important information at its finger tips, but too often it lies dormant in a desk drawer or is the private knowledge of the inspector. At Jack & Heintz every effort is made to publicize this information, to get it into the hands of production and to take action on the findings.

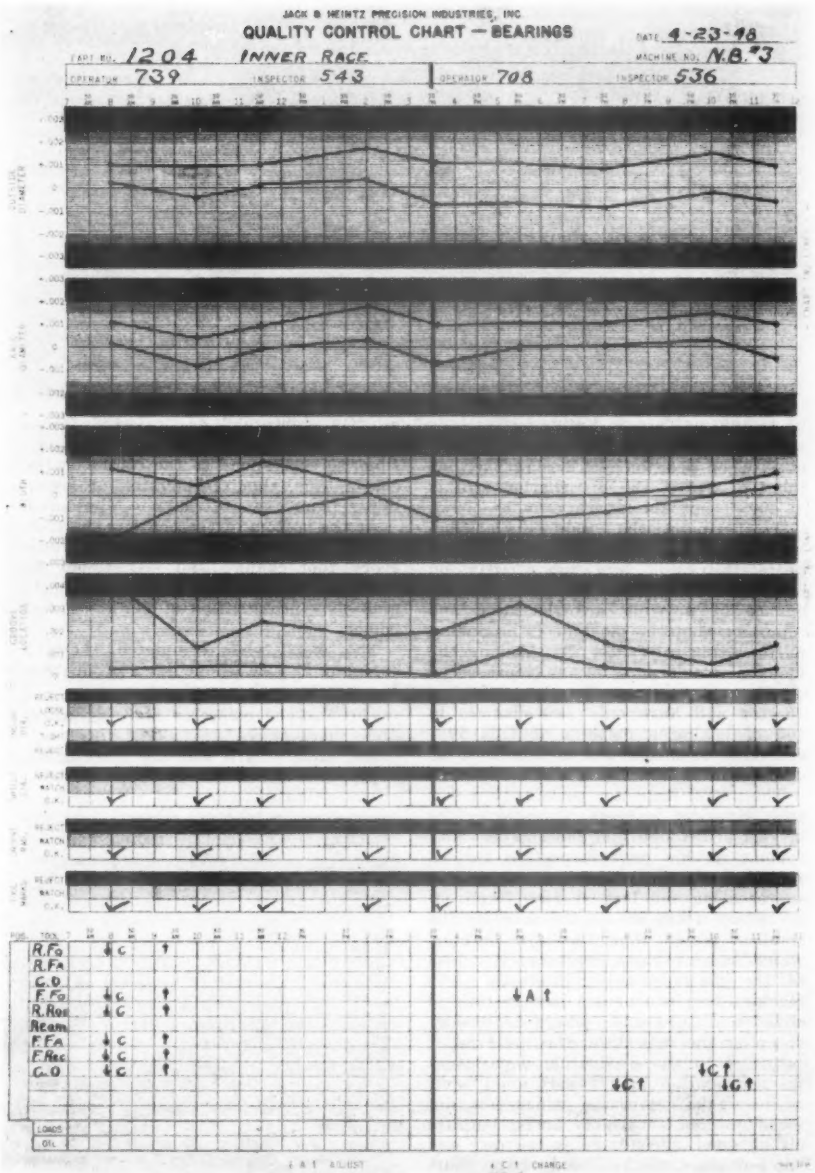
by Jack L. Shafer
Superintendent of Inspection
Jack & Heintz Precision Industries, Inc.
Cleveland, Ohio

The patrol inspection functions as a control of man, method and machine; whereas, the station inspection is established to give an unbiased estimate of the over-all quality on a lot by lot basis. In the group control system used by the standards department, each group has a patrol inspector and a station inspector. The patrol inspector systematically roves through the production group, drawing exactly five (5) samples from each machine or operation (in the case of multi-spindle machines, one sample is drawn from each spindle). The findings of the patrol inspector are then posted on the control chart which is displayed at each machine.

The chart, Figure 1, which is maintained daily, is designed in colors to have as much eye appeal as possible so that all concerned will take a certain amount of pride in its use. Its color bands are laid out on a statistical basis, moving the red band in from the engineering tolerance to prevent a machine from producing defects which the inspector would miss due to the chance of sampling.

This concept of sampling error is graphically portrayed by Figure 2. A machine in operation cannot reproduce the same identical size in successive pieces, but distributes these pieces about some average size. The width of this distribution is dependent upon the accuracy of the machine. For illustration, in Figure 2, the machine is producing between $\mp$ .003" with an average of 0, assuming that the engineering tolerance

Fig. 1 (right). The control charts devised by Jack & Heintz employ color bands laid out on a statistical basis. These are shown in greater detail and interpreted in Figure 2.


JACK & HEINTZ PRECISION INDUSTRIES, INC.
QUALITY CONTROL CHART — BEARINGS
DATE 4-23-48
PART NO. 1204 INNER RACE
MACHINE NO. N.B. #3
OPERATOR 739
INSPECTOR 543
OPERATION 708
INSPECTOR 536
R.Fa
R.Fa
G.D
F.Fa
R.Rac
Ream
F.Fa
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G.D
LOADS
OIL
A ADJUST
C CHANGE

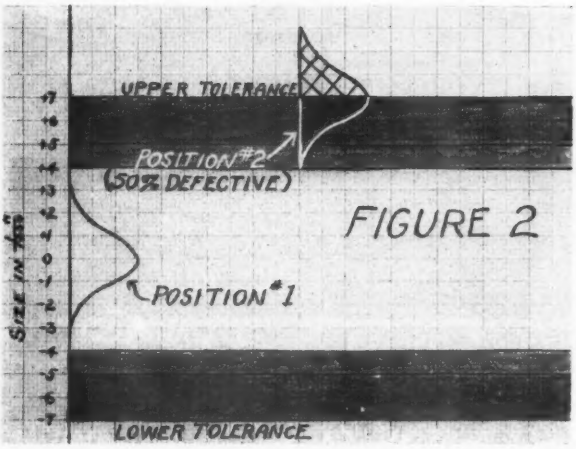

Fig. 2 (left). The bands printed in medium blue actually are red in the original Jack & Heintz color scheme. The red bands are moved in from the engineering tolerance to prevent a machine from producing defects which the inspector would miss due to the chance of sampling.

Fig. 3 (below). A chart of the operating characteristic of a sampling plan by which final quality is predictable.

is ∓ .007". This is quite satisfactory and no defects will be produced. However, when position No. 2 is reached, as the tool wears, the distribution still is ∓ .003", but the average is + .007".

At this point, the machine is producing 50% defective units. Now, the patrol inspector, working strictly on engineering tolerances, has a 50-50 chance of drawing an OK piece and reporting that the machine is producing parts within tolerance. By drawing the inspection tolerance in, as represented by the red band on the chart, the inspector will have only two chances in 100 of letting a machine that is 50% defective (position No. 2) continue to operate.

The patrol inspector posts with a dot, each time he inspects a machine, the largest size found and the smallest size found. At his next inspection this is repeated. As time progresses, the dots representing the largest piece are connected by a line as are the dots for the smallest pieces; thus, two lines develop, which, more or less, represent the path of the machine as it produces. Any machine that produces a part in the red zone is stopped and corrected. Besides stopping the operation, the material is returned to the production department for segregation into "good" and "bad."

Those characteristics which are not measured on a variable basis, but are either good or bad, as in a "go" and "no-go" gage, are recorded on the chart as "OK", "watch" or "reject". Gages used on the job are colored, where possible, to correspond to the colors on the chart; thus, the interpolation of action limits from gage to chart is eliminated.

At the bottom of the chart is the tooling record where the operator records every tool change and adjustment on each tool. Also, arrows are drawn to give an approximation of the amount of "down" time.

The chart, when completed, shows a complete history of one day's production. It answers such questions as:

(1) Did the inspector find any defective pieces?
(2) How erratic was the machine?
(3) How much was the down time?

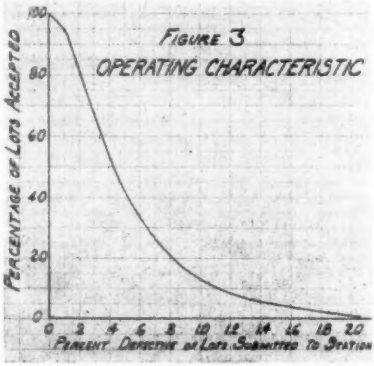

Fig. 4. Dial indicator faces employ the same red and blue color coding as the charts.

(4) Why was the machine down?
(5) What characteristic is most difficult to hold?
(6) Is this machine any worse or better than others?
(7) Is there a difference between the 1st and 2nd shift operator?
(8) How many times did the inspector inspect the operation?

The chart has a particular value to supervision because it readily points out the reason for defective work. For instance, if the chart is poor on both shifts, the machine's ability is questioned. However, if one shift's chart is good and the other poor, a difference in operators can be assumed since it is the same machine. Furthermore, as the foreman walks through the floor, he has to ask no one "how they are coming", for there on record is an unbiased picture of actual results.

The station inspection, to which the material is subjected after each operation, is based on a statistical sampling plan, which has a calculated risk of letting a small percentage of defective pieces slip by. However, if the material has a relatively high percentage of defects, the sampling will reject the lot and 100% inspection of the lot will take place. The race of the Jack & Heintz bearing is subject to three such station inspections during its production. Then, after the bearing is assembled and ready for shipment to the vendor, each lot of 1,000 bearings is sampled and inspected to very rigid requirements. If the sampling passes this inspection, the lot is considered acceptable for delivery to the customer; if the sample fails to pass, the lot is subjected to 100% inspection.

All of the defects which could be detected at these stations are classified by their importance into "major" and "minor" defects. A "major" defect being one which will not be found in subsequent operations or inspections and if missed would cause a failure in the field and a customer complaint. A "minor" defect is one which has no effect on the functioning of the unit but represents a departure from good workmanship.

A typical station inspection plan is as follows:

(1) From each lot of races presented, regardless of the size of the lot, remove 200 pieces.
(2) If no major defects are found, accept the lot.
(3) If two or more major defects are found, reject the lot for 100% inspection.
(4) If one major defect is found, an additional 400 samples are drawn.
(5) If no major defects are found in the second sample, the lot is accepted.
(6) If one or more major defects are found in the second sample, the lot is rejected for 100% inspection.

The risk of accepting defective lots and of rejecting good lots by this scheme is shown by the "operating characteristic of this sampling plan", Figure 3. By knowing and controlling these sampling schemes, the final quality is predictable, regardless of the quality which may be presented by production.

An interesting feature of the station inspection is in the manner it is used to assist the patrol inspector. The patrol inspector, on a few characteristics, is unable to perform an accurate inspection due to special instruments required which are not portable. To give adequate control of these characteristics, the patrol inspector, every hour on the hour, goes to each of the machines and

Fig. 5. Each peg on the pegboard represents a given production machine.

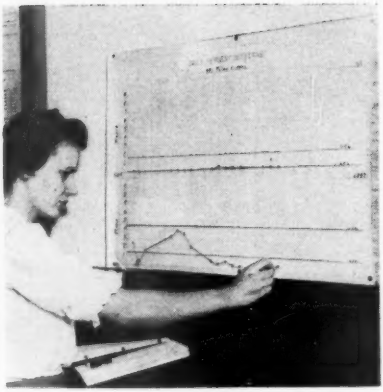

Fig. 6. Each day's sampling is posted on a large graph in each department.

collects, on a pegboard, five samples from each operation. The pegboard is merely a "two by four" with one 8" piece of dowel rod inserted for each machine, each peg identified with a machine. When a sample from each machine has been collected, the board is taken by the patrol inspector to the station where the samples are immediately inspected by the station inspector. Defects are noted and the patrol inspector is informed to stop the defective operation. In this manner an hourly patrol is maintained on characteristics that under normal patrol procedures would be quite haphazard.

The results of each day's sampling at the station is posted on a large graph in each Jack & Heintz department to inform operators and supervision of the trends in over-all quality, and to point out sudden spurts in either higher or lower quality.

The objective of these systems is twofold—to control quality in the most economical manner—and to publicize to the fullest extent all quality information. It must be recognized that adequate and correct systems can control quality, but to improve quality takes the whole-hearted cooperation of all personnel in a manufacturing organization.

Gage Control *(CONTINUED FROM PAGE 78)*

ized and intricate gaging mechanisms. These men are capable and creative machinists and are frequently called upon to develop or construct special gages where no blueprints are available, or to redesign unsatisfactory gages currently in use.

The number and location of the Gage Cribs are dependent on the degree of activity in the various manufacturing departments. At present there are five cribs widely dispersed throughout three-quarters of a million square feet of manufacturing area. The location of these cribs is by no means permanent. The present cribs will be moved as frequently as Plant Layout indicates that they can serve more efficiently from other locations.

Likewise, any part of the gage control program at Thompson Products, Inc., is subject to change if improvements or refinements are developed. The systematic control of gages is essential for assurance that quality will be maintained, because on the quality of the product rests the future of the manufacturing organization.

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Inspection of Master Form Crusher Rolls

Fig. 1. Form crusher roll for dressing wheels used in grinding thread rolling dies.

Methods for imparting a desired form or shape to a form grinding wheel have changed during the past few years. The original method makes use of single point wheel dressers in conjunction with a template conforming to the desired workpiece profile. For quantity production purposes, the newer method employs the form crusher roll.

The form crusher roll blank is hardened and then finish ground to the desired shape with particular attention to the maintenance of very close tolerances. This precision-ground roll thus becomes a master which can be used repeatedly to duplicate its form in the crush forming of grinding wheels.

The Jerpbak-Bayless Co., Chagrin Falls, Ohio, specializes in the manufacture of master form crusher rolls. These master rolls are used to dress grinding wheels which produce thread rolling dies, form tools and centerless-ground threaded workpieces. Figure 1 shows a crusher roll wheel dresser for grinding thread rolling dies, and Figure 2 illustrates a crusher roll which dresses a wheel for form tool production. Most any contour can be crush-ground as illustrated in Figure 3, which shows some of the typical profiles frequently used.

Because the crusher rolls must be held to a closer tolerance than that specified for the finished workpiece, the customers' specifications determine the tolerances to which the rolls are ground.

All rolls are hardened before grinding and, because the correct hardness is a critical requirement for long life of the rolls, Rockwell tests are carefully made.

The form roll must be concentric with its shaft hole. Checking this concentricity is performed by dial indicating the periphery with the roll mounted on an arbor held between centers.

Flats, angles and contours ground on form crushing rolls are checked on a Jones & Lamson comparator, Figure 4.

This comparator is an optical instrument used to check and inspect the crusher rolls by projecting a magnified shadow image of the roll profile onto a screen which incorporates an accurate profile chart of the desired contour. Thus, the shadow of the flats, angles or contours of a crusher roll appear magnified on the screen coincidental with the form chart, so that any deviation in the shape of the crusher roll from that specified is readily checked.

Lead or spacing of grooves is checked on a Pratt & Whitney electro-mechanical lead tester, Figure 5. This lead

Fig. 2. Form crusher roll for dressing wheels used in grinding form tools.

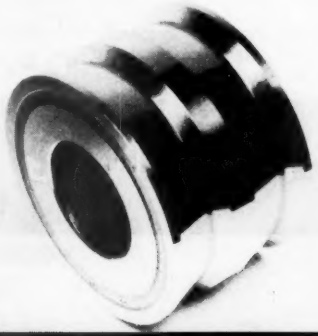
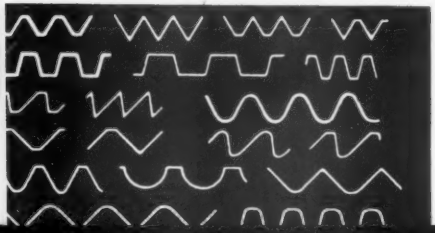


Fig. 3. Typical shapes and contours produced through the form crusher roll method.



tester is basically a combination of a precision, direct reading headstock, a carriage that is movable axially and supports a 15" sine bar and a pair of work-mounting centers, and an Electrolimit thread locating head with ball point. The threaded or grooved workpiece to be checked is mounted between centers, the ball point moved into thread contact and the instrument adjusted to zero on the milliameter. The ball point is then brought into contact with successive threads or grooves by turning the headstock handwheel. The milliammeter shows when the ball point is in proper thread contact, at which location the dials are read. Even inch carriage movements are controlled by Hope Gage Blocks and the headstock screw subdivides an inch. This instrument is not a comparator, but a direct reading instrument, capable of accurate readings to .000025".

After checking threaded or grooved crusher rolls on this precision instrument, Jerpbak-Bayless is assured of the accuracy of their work.

Depth of grooves and tapers, ground on crusher rolls, are checked on a Pratt & Whitney Electrolimit External Comparator, Figure 6.

The Electrolimit Comparator combines mechanical gaging with electrical magnification. It is arranged so that any mechanical movement of the gaging spindle is in contact and the pointer on the meter reads almost zero. Exact adjustment of the needle is made by the zero adjusting knob. The comparator is then ready to gage the workpieces, and the pointer on the meter will show any deviation from the standard. Many special applications are possible by means of special attachments. The three-wire attachment for checking depth of threads and grooves is used by Jerpbak-Bayless in the inspection of their master form crusher rolls.

Fig. 5. Pratt & Whitney Electro-Mechanical Lead Tester used by Jerpbak-Bayless in checking lead or spacing of threads and grooves.

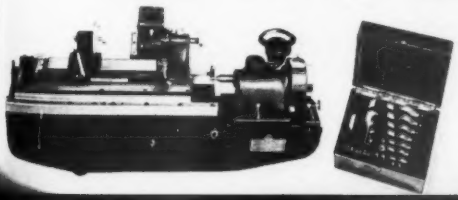


Fig. 6. In the Jerpbak-Bayless plant, the Pratt & Whitney Electrolimit External Comparator is used with its three-wire attachments for checking pitch diameters, depth of grooves and axial taper in thread form crusher rolls.

The standard procedure for determining pitch diameter by the three-wire method is used. The dimension over the "best size" wires for the thread being checked is noted and from this pitch diameter the thread depth is determined. Any variations from the computed value show on the Electrolimit meter as successive threads are checked, and the readings taken along the roll will show if there is any taper present.

Fig. 4. Jones & Lamson Optical Comparator used in checking flats, angles and contours.

Quality Control Through Statistical Methods

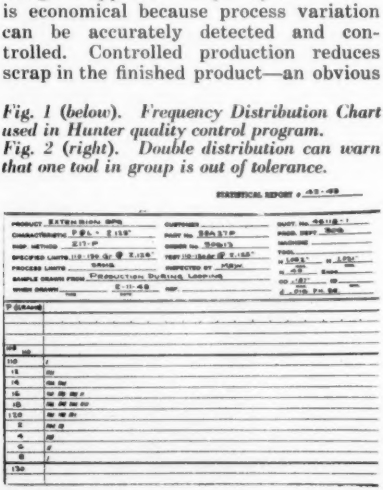
Controlling product quality is an ever-present problem in nearly every industrial operation. Much time and effort is usually spent in consultations, trial and error methods and guesswork, in trying to solve quality problems satisfactorily. Although most quality problems may be solved temporarily by such approaches, these methods frequently fail to contribute any information on product or process variability to help solve these problems permanently. Statistical methods, on the other hand, will give the quantitative measurements so necessary for permanent solution of any problem in product variation.

by F. C. Schulze
Chief Inspector
Hunter Spring Company
Lansdale, Pennsylvania

The statistical methods of inspection constitute the most economical and intelligent approach to quality control. It is economical because process variation can be accurately detected and controlled. Controlled production reduces scrap in the finished product—an obvious saving. Not so obvious sometimes is the reduction in cost which can be attributed to elimination of extra operations and increased machine availability. The statistical method is intelligent because by its use one can: (1) determine the process variability, (2) determine the quality of product at any time in the manufacturing cycle, (3) make sound decisions on manufacturing changes, (4) anticipate impending trouble and (5) establish tolerances with consideration of the process capability.

The Hunter Spring Company has used the statistical method of quality control advantageously for many years. It uses frequency distributions, correlation charts, and production control charts to control quality in every phase of its plant operation—incoming inspection, production and final inspection. The story of its application of statistical methods to production of quality springs is an interesting one. It was not only necessary to train personnel to accept and use the statistical approach, but it required also the development of many

Fig. 1 (below). Frequency Distribution Chart used in Hunter quality control program.
Fig. 2 (right). Double distribution can warn that one tool in group is out of tolerance.



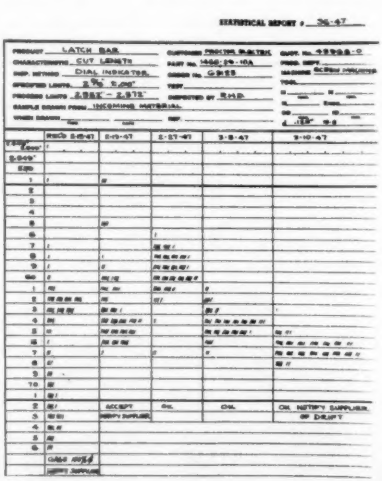


Fig. 3. Application of frequency distributions assists machine operator in his setup.

new measuring instruments. The purpose of this article is to give a brief description on the use of statistics in inspection.

Use of the Frequency Distribution

The Hunter Spring Company uses frequency distributions, Figure 1, in every part of its quality control setup. It is perhaps the simplest and certainly one of the most informative statistical methods available—graphic, easy to prepare and to understand.

Frequency distributions on a sample of the incoming product assure an accurate measure of quality. This form of sampling is not only much more informative but usually involves a lower inspection cost. In many cases, it will be possible to ascertain correctly how the defects can be eliminated despite the fact that we may have no knowledge regarding the vendor's manufacturing process. For example, Figure 2, a double distribution might mean that a manufacturer had mixed raw-material lots of a shipment of spring wire or, perhaps, that one tool in a group of tools was entirely out of tolerance. The frequency distribution provides a permanent record and permits easy evaluation of a vendor's process over an extended period.

Using frequency distributions at the beginning of an operation, such as the coiling of a spring, assists the machine operator in the setup. This inspection at first setup, Figure 3, is an extremely important procedure. "Getting off on the right foot" reduces scrap and rework.

Analyzing production problems is another important use of frequency distributions, permitting accurate determi-

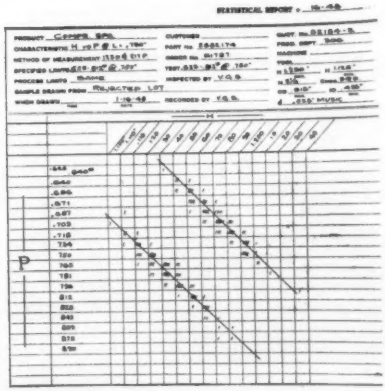


Fig. 4. This pattern disclosed mixed shipments of two very similar springs.

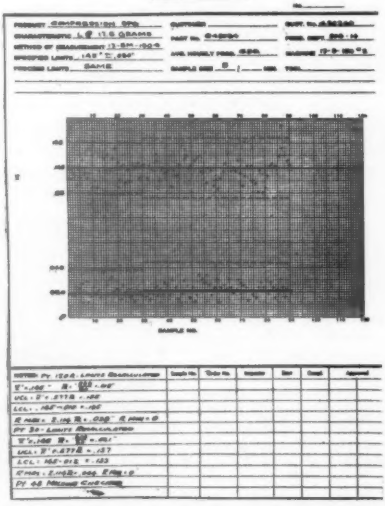


Fig. 5. Production Control Chart aids control of dimensions during production.

Fig. 6. Pressureless, length-measuring instruments are but a few of the special gaging and measuring instruments developed by Hunter for statistical quality control. The pressureless measuring gage operates manually and indicates electronically, and can be operated with speed and accuracy.

nation of the process capability. Knowledge of the process capability, in turn, makes possible precise price evaluations insofar as close or wide tolerances are concerned. Production irregularities such as tool and die wear, mixed lots and other such knotty problems are easily untangled. Thus, frequency distributions in the production line are invaluable.

Their use in the final inspection is also revealing. Not only does the customer get what he asked for but also he can have a record of it. The Hunter Spring Company, for example, sends a "quality report" covering each shipment of every item to each customer.

Correlation Charts

The correlation chart, Figure 4, is used to determine the relationship between two characteristics of a part. Its use in quality control is manifold. (1) By correlating an important, hard-to-measure factor with a relatively easy-to-measure factor, it is possible to set tolerances for controlling the easy-to-measure factor. For instance, in the spring industry, free length can be correlated against test load. In the case of length against load, it is sometimes easier to measure length and thus control the load. (2) The correlation chart is also used "to get out of trouble". In Figure 4 a customer complained that a shipment of springs did not meet specifications. A correlation of load against length disclosed that the customer had mixed shipments of two very similar but different springs.

Production Control Charts

Control charts are used in the pro-

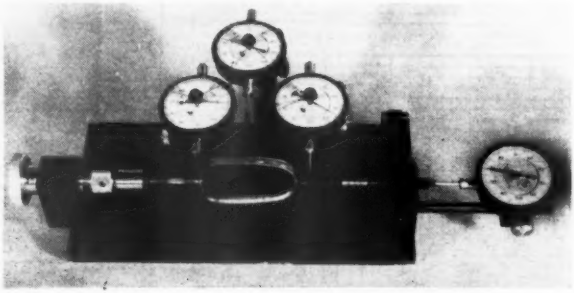


Fig. 7. A special gage employing "ganged" dial indicators for checking critical dimensions of a beater blade assembly. With a companion gage, it is used for control-charting four dimensions during brazing and for obtaining frequency distributions on nine different dimensions.

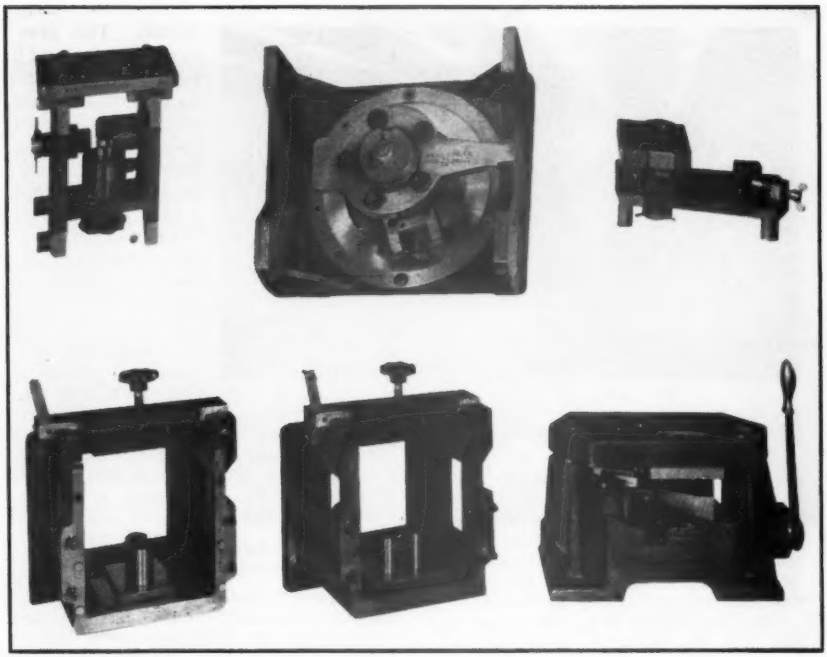


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Fig. 8. A typical inspection department grouping in the Hunter Spring Company plant.

duction department for quality control of long-run jobs. Figure 5 shows an example of this production control chart. Its uses are many and effective in controlling critical dimensions or characteristics during production. A few of these applications are: (1) to predict when a production process is going out of control, (2) to estimate variations in a process, (3) to eliminate uncontrolled variation and assign a cause for going out of tolerance, (4) to make comparisons between machines, (5) as a basis for establishing tolerances and specifications, and (6) to reduce the cost of final inspection.

When 100 percent inspection becomes necessary, the question of speed and accuracy is of great importance. At Hunter, a wide variety of electronically indicating instruments are used. However, the amount of such 100 percent inspection required has been greatly reduced through intelligent application of the statistical method during the manufacturing operation.

Pressureless Gages

Along with the development and use of statistical methods of controlling spring quality, the Hunter Spring Company designed and built many new precise measuring devices. These were necessary because the instruments available for measurement, such as micrometers and the like, would not give the accuracy which statistical methods required. The pressureless length measuring instruments, Figure 6, are only a few of the special instruments developed by Hunter for statistical quality control.

The pressureless measuring gage operates manually and indicates electronically. This gage can be operated with speed and accuracy. The part (spring, stamping, etc.) to be measured is placed in the instrument, the movable measuring head is operated until the electronic unit indicates, through a sound signal, that contact has been made with both ends of the part.

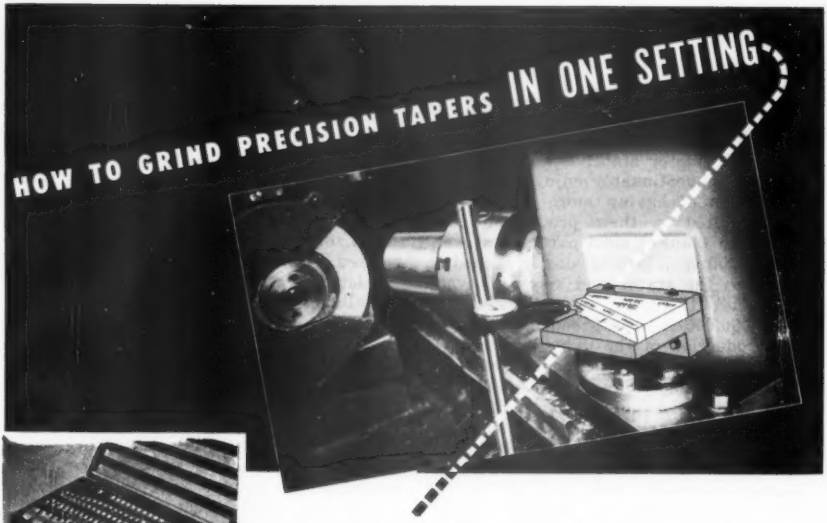
Gaging as Applied to Spring, Wire Forms, and Special Shapes

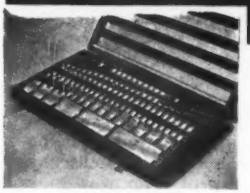
Figure 7 shows a special gage employing "ganged" dial indicators for checking critical dimensions of a beater blade assembly. This gage is used to obtain quantitative information as to how the dimensions of the part vary. This gage, and its companion gage, is used for control-charting four dimensions during the brazing operation and also for obtaining frequency distributions on nine different dimensions, all of which are reported with each shipment to the customer.

The use of customary go—no-go gages, micrometers, calipers, etc., cannot perform this function with the result that although substantially the same inspection effort has been expended, much valuable information has been lost.

The statistical method is the most practical and economical means of controlling product quality. Its use highlights the need for better, faster inspection equipment. At Hunter the design, development and building of inspection and testing equipment for springs has reached such proportions that this work is now handled by a separate division of the plant—devoted entirely to this work. Figure 8 shows one grouping of inspection equipment.

HOW TO GRIND PRECISION TAPERS IN ONE SETTING





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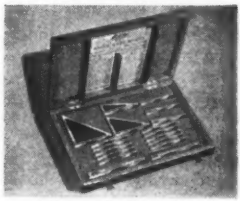

Angle Gage Blocks increase speed and precision of angle inspection.

Both internal and external tapers can be ground on any universal grinding head to an accuracy measured in millionth parts of a circle, through the simple application of Webber Angle Gage Blocks.

The trial and error of conventional methods is eliminated. What's more, the taper is true to tolerances that are difficult to maintain with usual procedure. The method is not limited to a single gage. Every setting can be inspected in a few seconds, making it unnecessary to use the time of a top notch toolmaker to achieve the necessary precision.

Write for bulletin of special angle gage applications — find out how angle blocks save hours of time each week and maintain positive control over angle grinding.

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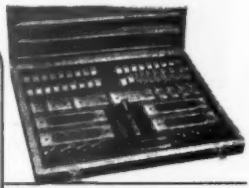

Transferring the extreme precision of gage blocks to the work without time taking precautions is one of the outstanding advantages of Webber Heavy Duty Gage Blocks and Fixtures.

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QUALITY
Measuring - Testing - Inspection
CONTROL

Angle Inspection of Lamination Tooling

Electric motor stator and rotor laminations unquestionably enjoy the unique distinction of having more presses and dies devoted to their production than any other blanked steel parts. An average of 200 such laminations is needed to complete the stator and rotor of every fractional HP motor. With an estimate of 50,000,000 motors produced annually, the production of the individual laminations runs into astronomical figures.

The problems of angles in laminations arise from the number and shape of slots. They vary with speed, acceleration and starting torque of the motor. It is only recently that motor manufacturers discovered that the laminations were best produced by building individual die segments. Maintaining a close supervision and inspection of segments, so that angle errors could be detected in the early stages, offered a constant problem. To provide inspection, a shop-built angle gage had to be made for each new motor design. In spite of the care in producing this gage, the results were never known until the job was locked into the press ready for blanking.

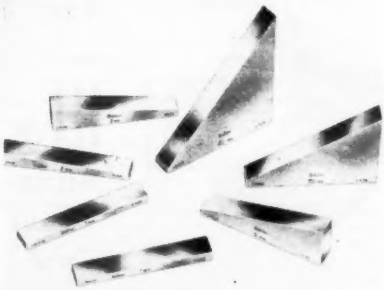
With the advent of the angle gage block some of the uncertainties were dismissed. For the first time an infallible yardstick was available.

Reliance Electric Manufacturing and Engineering Company of Cleveland recently adopted Webber angle gage blocks in their tool and die operation. Mr. W. R. Henninge, the tool and die supervisor, makes this observation: "Maintaining angle accuracy in die segments always involved extra care and precaution in setting up sine bar, assembling the proper gage blocks, looking for variables caused by wear and misalignment of grinder and the chuck plus the possibilities of careless use of sine table. All of these required continuous supervision and cross checking so that every source of error was under control.

"With the adoption of angle gage blocks our anxiety is tempered by knowledge that any phase of the grinding could be checked instantly and with positive results.

"The time in setup and inspection has been cut back as much as 50% over original method, to say nothing of the higher precision made possible."

An additional time-saving factor has



Angle Block above measures 11° 36' 46.45". This angle is used in generating a 31-slot lamination and is typical of the precision and time saving that are introduced when special blocks are made to replace combinations of 4 and 5 standard size blocks. Reliance tool engineers point out that such blocks save 75% setup and inspection time and also permit a direct check without resorting to sine tables.

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been introduced through the use of special blocks that replaced a combination of 3 or 4 angle blocks in constant demand. On one occasion, the specifications called for a 31-slot lamination with individual segments measuring 11° 36′ 46.45″. No existing combination of blocks would measure the 45/100 seconds that the segment required. However, the gage maker was called into the picture and at nominal cost produced a special angle gage that totaled precisely 11° 36′ 46.45″. Thus a 31-slot lamination was produced with greater precision and less trial and error than on any previous occasion.

An example of the difference in precision is easily compared in the grinding of a die segment for a 47-slot rotor lamination.

Each slot would require 7° 39′ 34″ angle. The sine of this angle is .666422 when used with a 5″ bar. Standard gage blocks could only approximate this figure: $.300+.142+.124+.1004=.6664$, thus permitting a small error to creep into the building of the die segment. In ordinary practice an allowance is made, in finishing the die, that would absorb this error. Nevertheless, the die would not be perfectly true, except for considerable care and judgment on the part of the die maker.

With Webber angle gage blocks this procedure is considerably simplified by merely combining the blocks so that the required assembly totals 7° 39′ 34″.

Here is the combination that yields that angle:

$5° + 3° - 1° = 7$ degrees
$30′ + 5′ + 1′ = 39$ minutes
$30″ + 5″ - 1″ = 34$ seconds

Its advantage lies in the ease with which it can be inspected, the speed of the assembly, plus its absolute precision.

The idea of angle blocks is not new. They have been suggested on many occasions. A simplified method was worked out by G. D. Webber for breaking up a circle so that a few blocks could measure thousands of angles in degrees, minutes and seconds. Having the equipment to grind and lap optically flat and parallel surfaces made the job of angle generation easier.

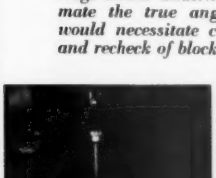
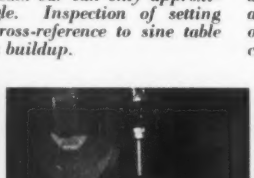
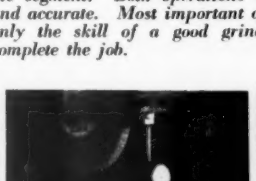
Angle blocks are not arbitrary units of measurement. The blocks have the unique distinction of proving their own accuracy by very simple, foolproof, geometrical setups.

Recently the Bureau of Standards adopted the blocks after carefully checking their accuracy. Their easy application was one of the outstanding reasons for using them in their own laboratories.

Conventional sine bar being inspected for squareness (left) and angle accuracy (right). Gage blocks underneath bar can only approximate the true angle. Inspection of setting would necessitate cross-reference to sine table and recheck of block buildup.

Chuck being set to an angle of 7° 39′ 34″. Here, illustrated at left, the blocks are being lined up for squareness; indicator checks vertical surface of blocks.

The final step (at right), preparatory to grinding, shows reading being taken to prove accuracy of setting. Chuck is now ready to grind die segment. Both operations are fast, sure and accurate. Most important of all, it needs only the skill of a good grinding hand to complete the job.

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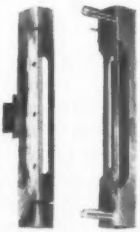
Gone is the old fashioned theory that most forming, blanking and stamping operations must be done on large, cumbersome presses. On the small run production job illustrated here, a farm machinery manufacturer was able to save considerably in both die and production costs by utilizing a standard KRW 75-ton press and low-cost dies as shown at the right.

Today, the term "arbor press" is a misnomer. In countless plants KRW Presses are doing thousands of jobs that, a few years ago, would have been done on larger equipment. KRW Hydraulic Presses are built in sizes varying from 25 to 100-ton capacities. All but the 100-ton press can be furnished as either hand operated, air operated or motor driven. Openings, bed widths, heights, etc. can be varied at very little extra cost to meet particular needs.

Before you buy a press, remember this truth — more often than not, "you don't need a sledgehammer to drive a tack." You can save plenty by bringing your production problem to KRW first. We're equipped engineeringwise to offer real help, no obligation of course.



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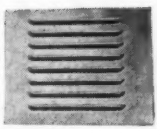

Illustrated at the left are the low-cost dies used by John L. Bubb Farm Machinery Co. of Baldwinsville, N. Y. on their KRW Press to form louvres in 16 ga. sheet steel as shown at the right. 3 tons pressure is required to shear and 10 tons to form the louvre. This is a highly economical set-up for the limited production necessary.

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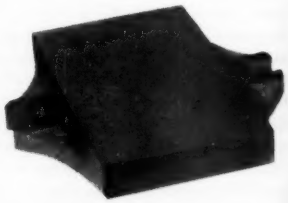

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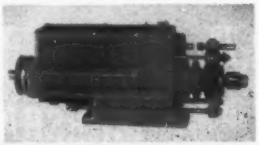

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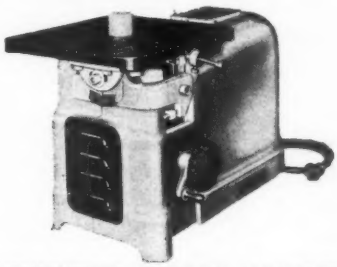

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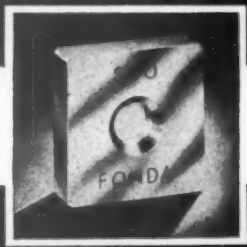

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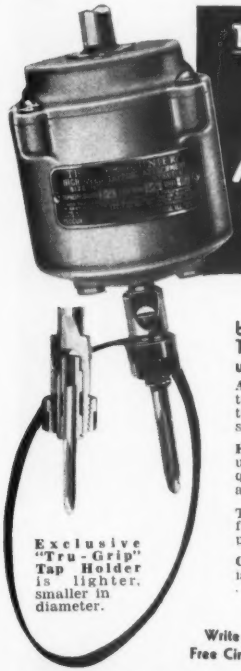

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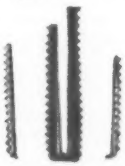

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PLAIN INDEX CENTERS
Can Be Used on ANY Milling Machine

KEMPSMITH ARBORS
in all popular sizes or types. Adaptable to ANY make of milling machine with standardized spindle.

Kempsmith Plain Index Centers for production and general indexing . . . simplify job set-ups . . . relieve the operator of the necessity of counting or making any calculations. Indispensable in milling taps, reamers, small gears, sprocket wheels, special grooving, etc. Described in Bulletin No. 124.

Kempsmith Standard Attachments broaden the scope of your milling machine . . . lower capital investment . . . save in set-up time.

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Precision Built Milling Machines Since 1888

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Die designer, now employed, experienced in the design and making of tools and gages; capable of sheet metal product design, seeks location near country living. Address Box HC-1048, TOOL & DIE JOURNAL, 1975 Lee Road, Cleveland 18, Ohio.

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Federal Machine Buys Warren City

The Federal Machine & Welder Co. has purchased the plant and contents of the Warren City Mfg. Co. from the U. S. Navy.

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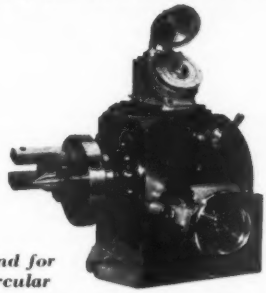
Presenting the Model O-P-L

Optical Precise Legible DIVIDING HEAD



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Realizing the need for dependable specifications based on research and testing—the only logical way to achieve economy in purchasing—the National Bureau of Standards has compiled, in directory form, all the standards and specifications in general use for commodities produced or purchased in this country. In compiling this material, every effort was made to obtain up-to-date information on standards and specifications from all national organizations that represent industry. Over 500 organizations contributed, including trade associations, technical societies and Federal Government purchasing agencies.

Manufacturers are becoming more and more aware of the importance of careful selection of materials. To determine the value of any material for a given purpose, its properties must be measured. Standardized testing methods based on conditions met in service are necessary for an adequate specification which must be a concise, definite and complete statement. Thus a satisfactory specification is not easily prepared. Mere inspection is not enough. Laboratory research is necessary, and often accelerated tests. The testing methods themselves require great care and skill and experience. The National Bureau of Standards has endeavored, then, to simplify this task by bringing about widespread use of specifications and standards with the publication of their guide, "The National Directory of Commodity Specifications".

The two volumes comprising this directory of 1633 pages, provide a complete listing by name, designating number, and issuing or sponsoring organization. The two volumes cost $6.25 and are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

It's NEW...

It's a "Knock-Out"

8 MODELS from 1/4" to 7/8"

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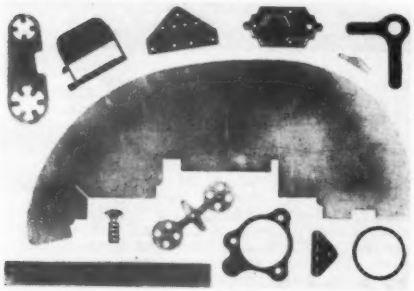
SHORT Patent Process OR LONG *High Production* RUN



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Capacity for large overall blanks at LOWEST POSSIBLE TOOL COSTS!

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Gages precision holes 1/8″ to 8″ dia. to fractions of .0001″

This indicating gage shows ACTUAL SIZE, with a fixed (not passing) reading. Because of this, it is ideal for a Quality Control setup; shows the diameter of any part of a hole, detecting out-of-round, front or back taper, barrel shape, bell mouth, reaching to the very bottom of blind holes. Automatic features assure accuracy independent of human variations. Used by machine operators (where quality *actually is controlled*), bench inspectors, final inspectors. Light, portable, no wires or hoses, this is truly an UNRESTRICTED gage, giving you precision gaging at every step of the Quality Control cycle.

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"COMTORGAGE", Precision External Comparator: Bulletin 30
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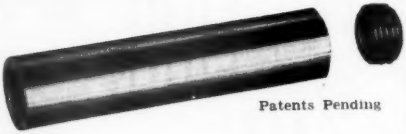
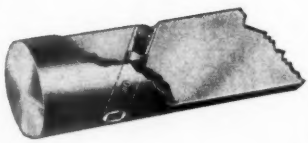
How SQUARE HOLED SLEEVES SPEED UP TOOL-MAKING!

One of the most difficult problems in tool making can be solved easily and quickly with Sturdy Square Holed Sleeves. The perfection of broached square holes can be had in boring bars, milling cutters and many other applications at a small fraction of the cost of imperfect hand-made square holes. The Sturdy Square Holed Sleeve consists of a round sleeve with a perfectly square hole broached through the center. This hole is tapped at one end to receive a back-up screw which is furnished with the Sleeve. The Sleeve can be sweated or pressed into a drilled and reamed hole to make a perfectly square accurate hole in a very few minutes.

The Sturdy Square Holed Sleeve will save you many hours and many dollars in the making of boring bars, tool holders and other tools requiring square holes.



Patents Pending



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FRICTIONLESS AMPLIFICATION

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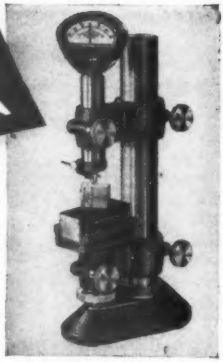

NO friction, lag or backlash . . . no racks, pinions, gears, levers, etc. subject to wear. Pointer responds instantly without swinging past true reading. Amplification is 100% mechanical, no lights or electromagnets, no warming up period required. Easily moved to different locations as there are no electrical connections. Our engineering department is at your service for applying Mikrokator to your measuring problem.

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Graduated — .0001" to .000002"

Graduated — .001 mm to .0002 mm.

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Flexolap... INSTANTLY AND ACCURATELY

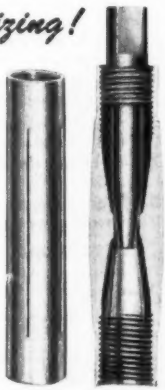
ADJUSTABLE FOR FAST CUTTING AND POLISHING

... without danger of galling or seizing!

The Flexolap barrel is made with a series of longitudinal slots milled "off-center" to permit sensitively flexible expansion up to 15% — or more — under pressure of the adjusting pin. This construction enables Flexolap to save valuable time and to lap rounder, straighter holes. For accurate precision take-up, as desired, to maintain size and compensate for wear on barrel . . . simply turn adjustment screw.

Illustrated at left is Set No. 1. Six sizes (3/16", 1/4", 5/16", 3/8", 7/16" and 1/2") with six brass and six steel barrels on wood stand, complete.....**$12.75**

Also available in sizes 7/32", 9/32", 11/32", 13/32", 15/32", 9/16", 5/8", 11/16" and 3/4". For lapping holes smaller than 3/16", use the *Midget Lap*. Fourteen sizes: .032, .036, .040, .046, .054, .070, .079, .090, .104, .120, .135, .155, .170. Trial assortment (14 laps)....**$1.50**



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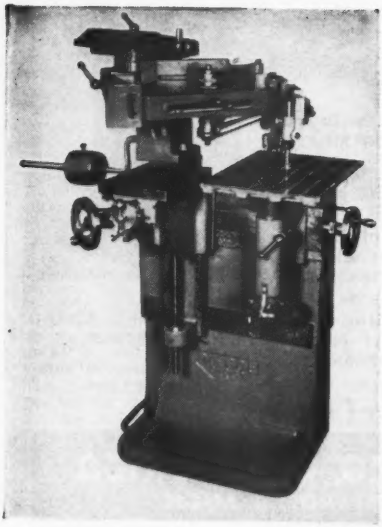
FEDERAL TOOL CORP., 3601 PRATT BLVD., CHICAGO 45, U.S.A.

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS



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Three Dimensional

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1. A means of reducing your production costs on intricate and difficult dies.
2. We invite comparison of quality, of workmanship, and performance.
3. Our inspection department rejects spindles that run out more than .0001".
4. Electronic dynamic balancing of all rotating parts.
5. We invite you to arrange to call at our factory to see and operate this machine.

For details write:

Pierce Machine Tool Co.
617 W. Jackson Boulevard
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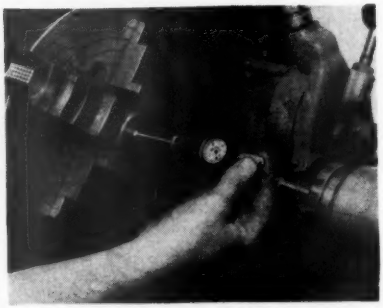
Nilco Dial Bore Gage

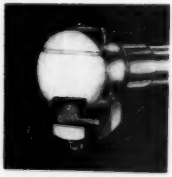
Simplified checking of bored hole dimensions with greater speed, precision and accuracy, are some of the salient features of the Nilco Dial Bore Gage, manufactured by the Nilsson Gage Company, Inc., Poughkeepsie, N. Y. The gage has two-point measuring and three-point alignment which assures centralization in the center of the bore at all times, regardless of what position the gage is held in the bore, as shown in the boring operation picture.

No wrenches, screws or washers are



required for setting the gage head, as the range extension is controlled by a knurled locking sleeve and locked in position by a lever. A patented "L"-shaped range extension makes possible the fast setting of this dial gage. The range extension in the open and closed position is shown in the two small illustrations.

Descriptive literature and complete details are available from the NILSSON GAGE CO., INC., Dept. 15, Lake St., Poughkeepsie, N. Y., or circle Inform-A-Gram Key No. D46.



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The New CROWN E-Z MARK ETCHER

Now you can permanently etch onto any type metal tool or name plate any name or trade mark that can be drawn, typed or written—with the new Crown E-Z Mark Etcher. It's fast, permanent, easy to use, economical and safe. It's the most amazing marking tool ever made for production marking or for individual identification.

To operate, merely place piece to be marked, round or flat, on the previously prepared film—press the button —and presto! it's finished. Anyone can use it, on almost any type of metal, and the mark lasts forever. Each film can be used for marking up to several hundred pieces—so it's economical too. No danger from shock—no acids to injure operator or clothes.

Send for Sample Etching

We will be glad to mark one of your products so you can see the quality mark you can make yourself. Send a sample or piece of your material with information you want on it. We'll do the rest.

CROWN *Industrial Products Co.*

1529 East 53rd Street **Chicago 15**

PROTECT PRECISION TOOLS

"Tool Coat"

(IMPROVED FORMULATION)

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- Positive Protection
- Ease and Speed of Application
- Substantial Money Savings
- Modern Packaging
- Assurance of Delivery in Good Condition
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"TOOL COAT" is a tough plastic with special rust inhibiting oils, high mechanical strength and resistance to shock and abrasion. Applied by dipping, it protects finely finished machine tools until the ultimate user peels off coating like a banana skin.

"TOOL KOTER" thermostatically controlled heating unit designed for proper melting of ethylcellulose and other thermoplastic compounds. Readily portable. Low wattage, all welded steel construction, heavy duty automatic thermostat, thoroughly insulated. Ready to operate including special heat transfer oil.

THE METHOD USED BY LEADING AUTOMOTIVE, AIRCRAFT, MACHINE TOOL MANUFACTURERS

Recommendations submitted without obligation.
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2749 North Lincoln Ave., Chicago 14, Ill.
Phone Eastgate 7-8100

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

NEW, TYPE-DX

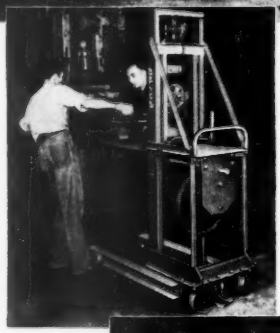
HEAVY DUTY

Shoplifter

Two Capacities

2000 lbs. and 1000 lbs.

A larger, huskier version of the popular Type D 500 lb. Shoplifter, but retaining the easy handling features of the smaller lifter. Platform and base frame have an overall width of 24" that allows easy passage in narrow aisles, between presses, and through doorways. Hoisting unit is ball bearing equipped. Automatic friction-disc brake holds load at any point, not necessary to set or release pawl or brake device. Only 20 lbs. pressure is required on crank handle to raise or lower load. Extra heavy construction gives rigid stability that enables the operator to handle maximum loads with ease and smoothness. No other lifter of equal capacity on the market can match the Shoplifter for value. One user said: "It's a lot of machine for the money."



SPECIFICATIONS

CAPACITY—1000 lbs. and 2000 lbs.
OVERALL HEIGHT (to clear)—6'8".
PLATFORM LIFT—54".
PLATFORM PLATE—24" wide x 27½" long (30" out from uprights).
BASEFRAME—24" wide x 50½" long overall. Open end front.
BASE WHEELS—5" fixed wheels, 6" swivel casters with push bar steer.
HOIST UNIT (two capacities)—Ball bearing equipped, crank up and down action, automatic safety brake holds load at whatever point raised. Drum scored for cable.
PAINTED—Standard olive green finish.
PRICE—1000 lb. capacity.....$320.00
2000 lb. capacity.....$370.00
f.o.b. Chicago, freight prepaid to any destination in U.S.
Heavy duty foot operated floor lock.....$15.00 Extra

Shoplifter Type D Capacity 500 lbs. Price $157.50

ECONOMY ENGINEERING CO.

4509 W. Lake Street, Chicago 24, Illinois

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PUBLICATION PREVIEWS

Keep Informed! CATALOGS • BULLETINS • SPECIFICATIONS

Circle postage-free Inform-a-Gram Key Number for your request

NEW QUALITY CONTROL SERVICE for tool steel users has been announced by Latrobe Electric Steel Company in a booklet recently published. Latrobe will supply hardened, tempered, polished and etched discs with every mill order for Desegatized Brand high speed and high carbon – high chromium steel bars. The prepared discs will afford consumers the unusual opportunity to inspect in advance the structure of the steel as it would normally appear after full heat treatment and processing into finished tools and dies. Exact control is thus assured. This pioneering service is described in detail in the booklet which is available by writing LATROBE ELECTRIC STEEL CO., Dept. 67, Latrobe, Pa., or by circling our postage-free **Inform-A-Gram Key No. B30.**

SAPPHIRE PLUG GAGES, RING GAGES AND MICROMETERS are graphically portrayed and listed as to price in a new 4-page color folder released by The Sapphire Products Division of Elgin National Watch Company. Also presented is the new "Tipt-Type" sapphire gage—an instrument with approximately one-quarter inch sapphire tip metallically bonded to the leading end of the steel member. Send for your copy of this price list No. 5 to THE SAPPHIRE PRODUCTS DIV., ELGIN NATIONAL WATCH CO., Dept. 89, 107 National St., Aurora, Ill., or circle our postage-free **Inform-A-Gram Key No. B31.**

A NEW GAGE FOR MEASURING FORM AND HOLE SIZES is announced by Penjaska Tool Company, Owosso, Michigan, in a colorful new bulletin. This inexpensive, hand gage combines telescoping and flush pin gage principles. The bulletin explains the action of the gage, and explains how expensive inspection setup, pouring of impression molds, and special gage making are eliminated by use of this handy new unit. Send for your copy to PENJASKA TOOL CO., Dept. 7, Owosso, Mich., or circle **Inform-A-Gram Key No. B41.**

DIAL SNAP GAGES, LARGE BORE GAGES AND SMALL DIAL BORE GAGES are the subject of a new booklet just off the press of Nilsson Gage Company, Inc., Poughkeepsie. The new snap gages magnify impersonally and mechanically all slight dimensional variations so that they can be easily seen without nerve or sight fatigue. This and many other features of Nilsson's three new gages are thoroughly discussed in the new bulletin available by writing NILSSON GAGE CO., INC., Dept. 15, Poughkeepsie, N. Y., or circle **Inform-A-Gram Key No. B42.**

ELECTRIC HAND TACHOMETERS are presented in a 4-page illustrated folder by their manufacturer, Metron Instrument Company. These Metron Hand Tachometers give accurate speed measurements of moving parts and thus assure the utmost efficiency of operation. Send for your copy to METRON INSTRUMENT CO., Dept. 391, 432 Lincoln St., Denver 9, Colo., or circle **Inform-A-Gram Key No. B28.**

TUNGSTEN CARBURIZED
T-C TAPS

Solve your tapping problems.

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300 to 1,000 Percent More Pieces Per Tap.

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A scientific advance in the field of Tungsten Carbide metallurgy

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Full information supplied promptly on request, without obligation — Write, wire or phone

RAY-METAL CO.
RIGID-CARBIDE-TOOLS

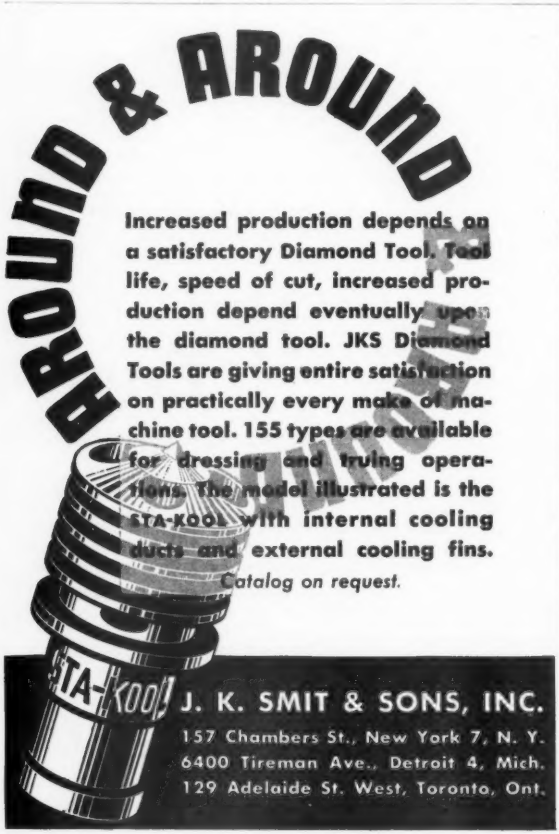
Walled Lake, Michigan

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PUBLICATION PREVIEWS

WEBBER HEAVY DUTY GAGE BLOCKS AND FIXTURES are photographed and discussed in a new folder recently published by The Webber Gage Company, Cleveland. The blocks can be assembled within a few seconds and applied directly to the work. The blocks have an accuracy of ± .000005" per inch of length or fraction thereof. Among the fixtures illustrated are the eccentric clamps for combining long blocks, and quick-acting clamps for combining fractional inch blocks. Diagrams and photographs show some of the applications of these ruggedly built, accurate blocks and fixtures. Also described is Webber's inspection service. Send for brochure to THE WEBBER GAGE CO., Dept. 621, 12903 Triskett Rd., Cleveland 11, Ohio, or circle **Inform-A-Gram Key No. B44.**

A PORTABLE, LIGHTWEIGHT PYROMETER, for all classes of heat control, is presented in a new folder by the manufacturer, The Pyrometer Instrument Company, Inc., Bergenfield, New Jersey. This totally self-contained, accurate and automatic pyrometer is ideal for checking instruments permanently installed, controlling furnaces, controlling objects in a furnace and for travelling inspectors. Its many features, principles of operation, working instructions, and specifications are all clearly described in the pamphlet which also has photographs and diagrams of the instrument. Also included are directions for its correct use, and reading instructions. Send for your copy to THE PYROMETER INSTRUMENT CO., INC., Dept. 57, Bergenfield, N. J., or circle **Inform-A-Gram Key No. B45.**


AROUND & AROUND
Increased production depends on a satisfactory Diamond Tool. Tool life, speed of cut, increased production depend eventually upon the diamond tool. JKS Diamond Tools are giving entire satisfaction on practically every make of machine tool. 155 types are available for dressing and truing operations. The model illustrated is the STA-KOOL with internal cooling ducts and external cooling fins.
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STA-KOOL
J. K. SMIT & SONS, INC.
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6400 Tireman Ave., Detroit 4, Mich.
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COLMONOY SPRAYWELD PROCESS—the application of Colmonoy alloys in powdered form—is simply and dependably accomplished with the Spraywelder. The final result is a fusion bond between the sprayed overlay and base metal. This process is presented on a handy metal-bound, 25" by 18" wall chart put out by Wall Colmonoy Corporation, Detroit. Six different types of Colmonoy are explained in large easy-to-read copy. WALL COLMONOY CORP., Dept. TJ, 19345 John R. St., Detroit 3, Mich., or circle **Inform-A-Gram Key No. B37.**

GENERAL INFORMATION AND SPECIFICATIONS ON ACE DRILL JIG BUSHINGS are included in a new catalog released by West Coast Aero Tool Company, Los Angeles. Price lists for West Coast's various types of drill jig bushings are given in the catalog, and on the back cover there is a "Time Saver Table" for the quick determining of number of parts which can be made from a given amount of material. Send for copy to WEST COAST AERO TOOL CO., Dept. 65, 5401 Fountain Ave., Los Angeles 27, Calif., or circle **Inform-A-Gram Key No. B38.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

PARKSON GEAR TESTERS, in sizes ranging from 4½" to 36" capacity, are illustrated and described in George Scherr Company's new ten-page folder. The folder discusses fully the up-to-date Parkson Gear Testing system and points out how rapidly gear faults and errors can be determined by employing Parkson testers. Specifications of the different sizes are included. Send for a copy to GEORGE SCHERR CO., INC., Dept. 490, 200 Lafayette St., New York 12, N. Y., or circle **Inform-A-Gram Key No. B46.**

LOCKE THREAD GAGES are described in a new 8-page brochure by the Locke Gage Company, Detroit. Cross-sectional drawings and photographs illustrate Locke's thread plug gages and thread ring gages, and their dimensions and ranges are charted. Also included are complete price lists of both types of gages, and interesting data on their construction and design. Send for your free copy to LOCKE GAGE CO., Dept. 72, 10232 Woodward Ave., Detroit 2, Mich., or circle our postage-free **Inform-A-Gram Key No. B47.**

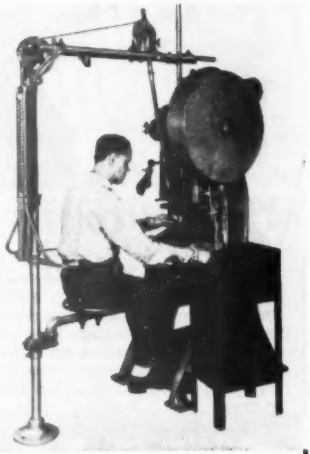
LIFETIME CARBIDE AND STEEL GAGE BLOCKS are discussed in a new brochure published by their manufacturer, Fonda Gage Company, Stamford, Conn. Their toughness, expansion, wear resistance, accuracy, surface finish, corrosion resistance, stability, and wringability are thoroughly explained. Photographs of the gage block sets and their applications are scattered throughout the brochure. Also included is a complete price list. Send for a copy to FONDA GAGE CO., Dept. 998, Stamford, Conn., or circle **Inform-A-Gram Key No. B48.**

SURFACE COMPARATORS AND INTERNAL COMPARATORS are the subjects of two bulletins published by The Comtor Company. Model No. 6, quick-scanning surface comparator, for rapidly comparing the surface finish of production parts with a standard, is presented in detail in Bulletin No. 32A. Because of the comparator's quick action, work can be moved rapidly, permitting quick inspection of the entire surface or as much of it as desired. Photographs of the comparator in operation, specifications, and detailed descriptions of the machine are included in this Bulletin No. 32A.

Comtor's Bulletin No. 33 describes the Comtorplug for precision internal 2-point gaging. The Comtorplug provides a fixed, not a passing reading and shows actual size. It will accurately determine measurements to fractions of one ten-thousandth inch. This Bulletin No. 33 gives all the basic information concerning the Comtorplug—its operation, specifications, price, capacities. Send to THE COMTOR CO., Dept. 3, 87 Rumford Ave., Waltham 54, Mass., or circle **Inform-A-Gram Key No. B55.**

You can make your punch presses
positively safe
with **POSSONS**
POSITIVE SAFETY DEVICES

The new Red Arrow Pull-Out Multiplier makes "Possons Positive Safety Device" the most efficient, dependable and practical means yet found to make punch press operation safe!



WRITE FOR COMPLETE CATALOG TODAY

The **POSITIVE SAFETY MFG. CO.**
4406 Perkins Ave. Cleveland, Ohio
Engineering Service Upon Request

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

LUFKIN PRECISION TOOLS, cataloged by The Lufkin Rule Company, include micrometers; calipers; dividers; combination and other squares; center, depth, planer, radius, screw pitch, telescoping, thickness and other gages; steel scales; and related items. Built to maintain their reputation, these tools are all of the highest grade and embrace many exclusive features. Catalog No. 7 is a handy, pocket-size, 128-page, profusely illustrated book which is available by writing THE LUFKIN RULE CO., Dept. 609, Saginaw, Mich., or circle **Inform-A-Gram Key No. B51.**

THE ADVANTAGES OF CARBIDE GAGES are put forth in a new brochure published by Lincoln Park Industries, Inc. The brochure samples typical reports received by the company in which considerable savings have been effected through the use of carbide gages. Copies are available at no cost by writing to LINCOLN PARK INDUSTRIES, INC., Dept. 73, Lincoln Park 25, Mich., or circle **Inform-A-Gram Key No. B52.**

CADILLAC'S NEW PORTABLE PLA-CHEK GAGE has all the proved features of the larger Pla-Chek gage. It is fully described and its capabilities are discussed in Cadillac Gage Company's new folder, CG-452. The folder also includes photographs and descriptions of other Cadillac products including Stellite thread plug gages, steel thread plug gages, steel thread ring gages, and reversible thread plug gages. Send to CADILLAC GAGE CO., Dept. 61, 20316 Hoover Rd., Detroit 5, Mich., or circle **Inform-A-Gram Key No. B53.**

Do it
EASIER !
FASTER !!
BETTER !!!
FOR LESS !!!
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Zagar COLLETS and FIXTURES
Using 2" Zagar Index Fixture on U. S. hand mill, milling hexes on bolts.
Just words? Well, just try Zagars! For milling, drilling, tapping, slotting, grinding and turning with collets — without special tooling. Note these points: holding or indexing with collets, horizontally or vertically; air-operated or not, fully automatic or manual; load and unload while running; collet lathe chuck.
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PRODUCTION TOOLS
ZAGAR TOOL, INC.
Dept. TD-10, 23880 Lakeland Blvd., Cleveland 17, Ohio
ZAGAR COLLET TOOLS
Zagar INDEXING AND HOLDING FIXTURES

THE BINOCULAR HEAD-BAND MAGNIFIER has many advantages for craftsmen doing high precision work or inspection jobs, as well as engravers, watchmakers, jewelers, etc. The manufacturer, Carl Zeiss, Inc., has available an interesting leaflet profusely illustrated with various applications of the Magnifier. The Magnifier leaves both hands free and permits the use of both eyes, thereby revealing the true depth of details, as well as the thickness and shape of the object being viewed. The pamphlet is available by writing CARL ZEISS, INC., Dept. 945, 485 Fifth Ave., New York, N. Y., or circle **Inform-A-Gram Key No. B58.**

A NEW GENERAL CATALOG, NO. M-1646, has been published by The Cincinnati Milling Machine Company. Divided into six sections, the 44-page catalog is filled with interesting illustrations, technical data, and specifications of the different machines which include milling, broaching, cutter sharpening, grinding, lapping, and flame hardening. Send to THE CINCINNATI MILLING MACHINE CO., Dept. 233, Cincinnati 9, Ohio, or circle **Inform-A-Gram Key No. B59.**

MOORE'S LOCATING MICROSCOPE easily picks up edges, contours, irregular shapes, and holes too small for an edge finder or indicator. It reverts the image to an upright position and magnifies 40 times. Moore Special Tool Company, Inc., has issued an informative, profusely illustrated catalog which describes in detail the uses and applications possible with the Moore Locating Microscope. Although specifically designed for the Moore jig borer and jig grinder, it may be attached to any machine or inspection tool requiring an optical pickup device. Also included in the brochure are instructions for aligning optical center of the microscope. MOORE SPECIAL TOOL CO., INC., Dept. 589, 740 Union Ave., Bridgeport 7, Conn. **Inform-A-Gram Key No. B49.**

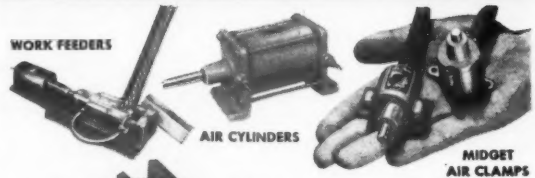
THE VARIABLE CENTER SCOPE, for accurately locating layouts on machine tools, is described in a pocket-size brochure by the manufacturer, Center Scope Products, Glendale, California. It may also be adapted easily to inspection operations. The brochure is profusely illustrated with photographs of actual job applications. Features and specifications are given in detail. Write to CENTER SCOPE PRODUCTS, Dept. 585, 3829 San Fernando Rd., Glendale 4, Calif., or circle **Inform-A-Gram Key No. B56.**

TO EVALUATE AND TO COMPARE SURFACE FINISHES BY OPTICAL MEANS is now possible with the Comparoscope, which is presented in an illustrated folder by the manufacturer. The Comparoscope is a dual microscope, equipped with a master-stage and a base with an adjustable stage. Thus it is possible to view and compare two surfaces simultaneously. The folder contains diagrams and drawings which clearly illustrate the working principle of the Comparoscope. Send for a copy to THE COMPAR-INSTRUMENT CO., Dept. 1, Detroit 3, Mich., or circle **Inform-A-Gram Key No. B57.**

"SHOP MEASUREMENTS WITH LIGHT WAVES To Millionths of an Inch" is an informative book available from Acme Scientific Company. The booklet explains the practical everyday use of light wave in shop measurements and is based on Acme's own shop experience. With Acme optical equipment it is an easy procedure to measure to hundred-thousandths and millionths of an inch. Detailed discussions and instructions, illustrated with photographs and drawings, show the various applications of Acme's optical flats, toolmakers' flats, and monochromatic light. The booklet is available free by writing ACME SCIENTIFIC CO., Dept. 52, 1450 W. Randolph St., Chicago 7, Ill., or circle our postage-free **Inform-A-Gram Key No. B50.**

NEW MEAD INDUSTRIAL

AIR POWER CATALOG Ready!



Full of Suggestions for **FASTER, CHEAPER PRODUCTION!**

Illustrates, describes Air Cylinders, Valves, air operated Presses, Vises, Chucks, Hammers, Drill Press Feeds, Work Feeders, Timers, semi-automatic combinations, etc.

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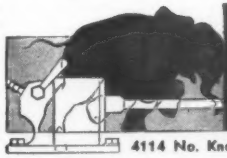


MEAD SPECIALTIES COMPANY

4114 No. Knox Ave., Dept. HA-108, CHICAGO 41, ILL.

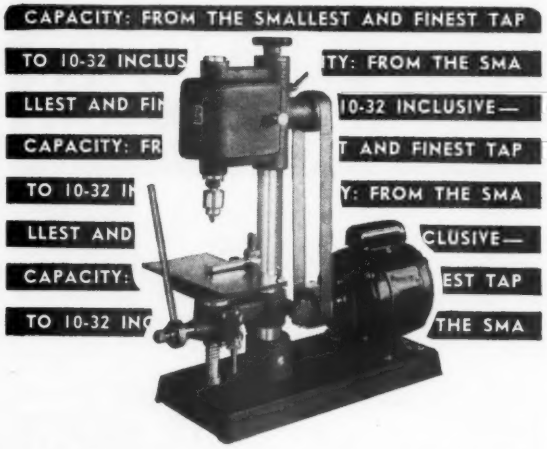
SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PUBLICATION PREVIEWS

ABRASIVE BELT AND WHEEL MACHINERY for grinding, polishing and deburring are presented in a new catalog, No. 325, by Hammond Machinery Builders, Inc. Hammond's many models of abrasive belt grinders, polishing lathes, "no dust" and "OK" grinders, and backstands are pictured. Design features and specifications are given, as well as close-up illustrations of the various attachments and of job applications. A thorough and comprehensive catalog, it is available by writing HAMMOND MACHINERY BUILDERS, INC., Dept. 95, 1600 Douglas Ave., Kalamazoo, Mich., or by circling **Informa-A-Gram Key No. B14.**

INFORMATION ON BRONZE PRODUCTS AND ALLOYS is contained in a condensed bulletin (No. 95) issued recently by Ampco Metal, Inc. Besides various alloys, the product range covers bronze rod and sheet, non-sparking safety tools, resistance and arc welding electrodes, corrosion-resistant centrifugal pumps, plug valves and fabricated assemblies. Many illustrations, charts on physical properties and welding tips, and technical data complete this informative bulletin available at AMPCO METAL, INC., Dept. 956, 1745 S. 34th St., Milwaukee 4, Wisconsin, or circle **Inform-A-Gram Key No. B11.**

A STREAMLINED SIX-SPINDLE AUTOMATIC INDEXING PRODUCTION PRESS is presented by Burg Tool Manufacturing Company in a new brochure. Known as Burgmaster, this high production machine has preselective spindle speeds and can be changed quickly and simply through six individual stations to reaming, tapping, drilling, spot facing, counter sinking and counter boring.



When tapping operations *must* be precise, and the materials used differ in characteristics as widely as paper and monel, or ceramics and bronze; then the precision and instrument industries should specify, and demand, the

HAMILTON SUPER SENSITIVE TAPPING MACHINE

Taps to the very bottom of blind holes. Reduces tap breakage to an absolute minimum. Built ruggedly . . . for fast and continuous service on tight production schedules.

WRITE FOR BULLETIN T-47

THE *Hamilton* TOOL COMPANY

SUPER SENSITIVE DRILLING MACHINES · TAPPING MACHINES · PORTALVATORS

832 SO. NINTH STREET · HAMILTON · OHIO · U · S · A

NORBIDE GAGES are made of the hardest material ever produced for commercial use and second only to diamonds in hardness. The result is that they have an unusual resistance to abrasion and scratching and therefore a long life. Their features and capabilities are described in detail in an interesting booklet published by the manufacturer, Norton Company, Worcester, Mass. Norbide is Norton's own patented product and is used for plug, ring, snap, radius and keyway gages; and inserts, micrometers, and indicator points. Send for booklet to NORTON CO., Dept. 545, Worcester 6, Mass., or use **Inform-A-Gram Key No. B60.**

THE DETAIL TAPERED PASS GAGE was developed for rapid visual-checking hole sizes in jig boring. Other successful applications include internal grinding, inspection, and use in tool and stock rooms. The manufacturer has issued an illustrated pamphlet describing its uses, sizes, and price. Send for copy to DIE-MAKER SUPPLIES CO., Dept. 36, 2679 E. Grand Blvd., Detroit 11, Mich., or circle **Inform-A-Gram Key No. B61.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

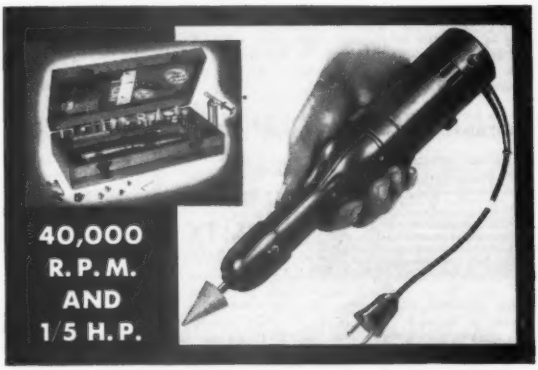
Specifications, speed chart table, and technical data are included in the brochure. Send for your copy to BURG TOOL MFG. CO., Dept. 7, 5028 W. Jefferson Blvd., Los Angeles 16, Calif., or circle **Inform-A-Gram Key No. B12.**

A NEW ABRASIVE CUTTING CATALOG has been released recently by the Andrew C. Campbell Division which features their new Model 223 Bar Cutter. This low cost wet abrasive cutting machine is designed to cut 2" diameter solid stock and 3½" tubing and will cut practically any material. The catalog, No. DH-30, is profusely illustrated with exterior and close-up views of the cutting action of the new machine. Also included are specifications and details. Send for your copy to Andrew C. Campbell Div., AMERICAN CHAIN & CABLE CO., INC., Dept. 185, Bridgeport 2, Conn., or circle **Inform-A-Gram Key No. B5.**

METAL FOR INDUSTRY is the title of a dramatic and colorful new booklet outlining Continental United Industries Company's metal production, research, and service. The booklet includes a short history of the company and its divisions. Quality Hardware and Machine Division furnishes dies to almost every industry in the country using punch press stampings. For your copy of this interesting resume of Continental United's history, or further information on their various services, write to QUALITY HARDWARE & MACHINE DIV., Dept. 436, 5849 N. Ravenswood Ave., Chicago 26, Ill., or circle **Inform-A-Gram Key No. B3.**

MODEL EO CLEVELAND LEAD SCREW TAPPING MACHINE for high speed, precision single or multiple small-hole production tapping, is detailed in a new bulletin distributed by The Cleveland Tapping Machine Company, Hartville, Ohio. The machine is capable of high production speeds with unvarying thread form—even on Class 3 and 4 fits. Tooling examples, illustrations and specifications are included in the bulletin available by writing THE CLEVELAND TAPPING MACHINE CO., Dept. 242, Hartville, Ohio, or circle **Inform-A-Gram Key No. B63.**

THE CLEEREMAN JIG BORER may be used as a precision checking and inspection machine, as well as for drilling, boring, and reaming. Measuring devices built into Cleereman Jig Borers permit checking precision products to .0001". Catalog No. 310 describes in detail the different operations possible with this versatile machine. Catalog No. 310 is available by writing to BRYANT MACHINERY & ENGINEERING CO., Dept. 54, 400 W. Madison St., Chicago 6, Ill., or use **Inform-A-Gram Key No. B62.**



IDEAL FOR CARBIDE CUTTERS

Speed with power with precision. PRECISE 40, the fastest, most powerful electric handtool made, weighs only 40 oz. *Built for production.* Mills, grinds, polishes, deburrs any material from file-hard steel to bronze, plastics, wood or rubber. Imagine, with tungsten carbide cutters PRECISE 40 *mills* the hardest steel!

PRECISE 40 is cool, shockproof, plastic case operates on AC-DC. Use it as a handtool or as a motorized quill in vise, lathe, mill or on your production set-up. Many accessories and rotary tools available. Also COOLFLEX Flexible Shaft attachment with 9-oz. air-cooled handpiece.

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MILLS
DEBURRS
ENGRAVES
DRILLS
FINISHES
SHARPENS
POLISHES

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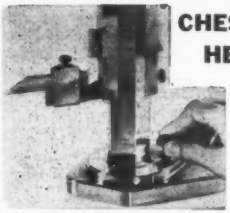
PRECISE PRODUCTS CO., 1341 CLARK ST., RACINE, WIS. U.S.A.

THE NEW PRECISE 40

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

SCHERR *aids to precision – production*

Will not shift while measuring—



CHESTERMAN HEIGHT GAGE

A big, sturdy stabilized instrument. Fine adjustment by screw operated from knurled nut on base (see photo) eliminates movement of instrument while measuring. Finger pressure on two lugs frees split nut for rapid vertical adjustment of head. 2½" long vernier in place of the normal ⅝" vernier provides greater visibility without need of magnifier or removing gage from work. English and metric readings one on each face of column. In sizes from 12" to 48"—capacities sufficient for the most unusual measurements.

Increase gage block usefulness

GAGE BLOCK UTILITY SET

Quick adjustable type holders. Greatly expands the usefulness of standard gage blocks. The set includes four holders—2", 4", 8" and 12", two jaws each for inside and outside measurements, a 60-deg. center point, and a substantial height gage base. Every shop can profitably use one or more of these economically-priced sets. Price, $98.50.

Check mikes and gage blocks with OPTICAL FLATS

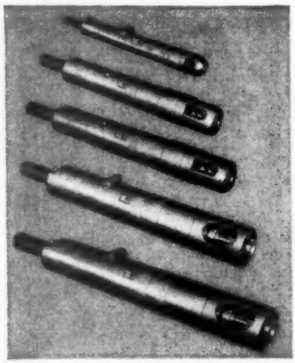
Essential for checking wear and flatness of lapped surfaces. Reveal deviation in millionths from absolute flatness or parallelism of micrometer anvil, gage blocks, refrigerator, airplane parts, etc. Sizes up to 4" or over. Price, 1¼", $10.

Write for full details on these tools and for the Scherr Small Tool Catalog

GEO. SCHERR CO., Inc.
197-A Lafayette St. New York 12, N.Y.

ENGINE AND TOOLMAKERS LATHES are the subject of a new 36-page catalog issued by The Monarch Machine Tool Company, Sidney, Ohio. The Series 60 lathes are described in detail in this Bulletin No. 1112 as to their design, construction, capabilities, and specifications. Many close-up photographs of the lathes in operation, their parts, accessories and products produced on them, help make the bulletin a most comprehensive and interesting study. Supplementing these data is a digest covering 37 different special accessories and attachments expressly developed by Monarch engineers to promote higher productivity at lower cost. Also included are eight pages showing the wide scope of quality control techniques utilized in the lathe manufacture. Bulletin No. 1112 is available free upon request to THE MONARCH MACHINE TOOL CO., Dept. 538, Sidney, Ohio, or circle **Inform-A-Gram Key No. B72.**

NEW TOOLS FOR MULTIPLE DRILLING are offered by Keller Tool Company, Grand Haven, Michigan, in a new folder. The new line, known as Airfeedrill Units, consists of five major units as illustrated below. The Airfeedrill is a combination of a Keller air drill, an air cylinder, and a hydraulic dashpot and feed control assembled in one housing and arranged for quick locking progressively in a jig or permanently into a fixture.



Thirty-four speed combinations of stationary and portable units are possible for drilling holes up to ¾" diameter in mild steel, aluminum, brass or plastics. Keller's folder, which is available at no charge, describes the new tools in detail, and illustrates them. Complete specifications, including diagrams and dimensions of the bushings and fittings, are included. Send to KELLER TOOL CO., Dept. 90, Grand Haven, Mich., or circle **Inform-A-Gram Key No. B73.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

CEMENTED CARBIDE TOOLS are offered in an attractive 70-page catalog, No. 48, by Kennametal, Inc., Latrobe, Pa. This is a most complete and diversified line and includes such items as: Kennametic Tools in five styles having indexable and replaceable solid Kennametal inserts, mechanically held in vertical position; Kendex Tools in four styles having indexable, replaceable flat Kennametal tips; Planer Tools in five styles for heavy and medium heavy duty planing of cast iron; Roll-Turning Tools for roughing, finishing, and fillet-forming of cast iron mill rolls. Many illustrations, specifications, technical data and diagrams make this catalog a most comprehensive study on cemented carbide tools. Send for your free copy to KENNAMETAL, INC., Dept. 33, Latrobe, Pa., or circle **Inform-A-Gram Key No. B77.**

NEW MAGNA EYE for vernier calipers and height gages has been developed by the Stebar Company, Minneapolis. Made in three sizes to fit the most popular and widely used calipers and height gages, it fits closely over the reading scale—magnifying the numbers and divisions so that they are quickly and easily read at all times. The lens is of finest optical quality glass. Literature is available describing the Magna Eye by writing STEBAR CO., Dept. 27, 711 West Lake St., Minneapolis 8, Minn., or use **Inform-A-Gram Key No. B74.**

HERCULES CARBIDE TIPPED DIE DRILLS are offered by their manufacturer, Whitman & Barnes in a new circular. The drills are designed for drilling hardened steel in range of Rockwell C40-65, and they will drill hardened dies without annealing or using the costly time-consuming grinding method. The drills may also be used for cutting through hard outer cases, and in drilling parts after hardening, thus eliminating the difficulties arising from distortion during heat treatment of previously drilled parts of intricate design. Specifications of the carbide tipped die drills are included in the circular. WHITMAN & BARNES, Dept. 502, 2100-2200 West Fort St., Detroit 16, Mich., or circle **Inform-A-Gram Key No. B78.**

SMALL UNIT PRODUCTION FURNACES, known as "Mighty Midgets", are presented in a folder recently put out by the manufacturer, K. H. Huppert Company, Chicago. Many outstanding features of this "Mighty Midget" are demonstrated in the folder, such as its automatically controlled temperature. Any temperature from 200° F. to 1750° F. may be set and automatically maintained. The power input is automatically balanced to heat demand. All this is incorporated into one small, light-weight (only 11 pounds) precision unit. K. H. HUPPERT CO., Dept. 76, 6864 Cottage Grove Ave., Chicago 37, Ill., or circle **Inform-A-Gram Key No. B79.**

NOW made of
M-2
HIGH SPEED
STEEL
MILFORD
REZISTOR
MILFORD
ALL-HARD REZISTOR
POWER BLADE
is a real Post-War blade!
Yes... today's REZISTOR is a post-war development... made from a modern high speed steel known as M-2. Newly perfected heat treatment has made possible new high cutting records.
The REZISTOR of 1940 was a splendid blade... but... the REZISTOR of 1948 will show far greater endurance, make more straight cuts per blade, and cut faster. Large quantities of blades, tested in our own laboratories, and on several makes of hack saw machines tell us this is true. They are our proving grounds. Your own machines are yours.
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● 28% more straight cuts
● 5% faster
Order from your mill supply distributor. He is always ready to serve your needs for all factory and mill supplies, as well as MILFORD hack saw and band saw blades.
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PUBLICATION PREVIEWS

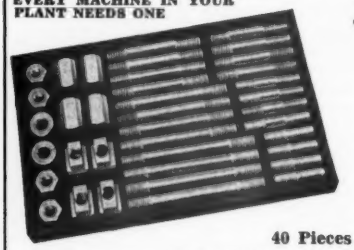
SPERRY'S SUPERSONIC REFLECTOSCOPE accurately and instantaneously locates internal defects in metals and other materials. This nondestructive testing machine quickly and easily tests raw stock, semi-finished or finished pieces. Sperry Products, Inc., has a bulletin, No. 3001, which not only illustrates the reflectoscope and its operation, but describes in detail the principle of operation, materials which can be tested, and the various advantages to the user—quality control-wise.

Sperry's Data Sheet No. 3700 presents the Sperry Reflectogage for measuring thickness of parts up to 4 inches. As access from only one side is required, it is especially suitable for testing long tubes, formed hollow parts, plate and sheet stock, large tanks and boilers, and ship hulls. Drawings and diagrams demonstrate the working principle of the Reflectogage and six pages of descriptive matter explain its application and operation. Send for Bulletin No. 3001, or Data Sheet No. 3700, to SPERRY PRODUCTS, INC., Dept. 85, Danbury, Conn., or circle **Inform-A-Gram Key No. B66.**

THE PROFILOMETER catches dimensional errors before they occur—thereby offering a new technique of quality control wherever parts are produced in quantity by machining operations. The start of defective cutting action is shown by an increase in surface roughness. The operating procedure of the Profilometer is described—step by step—in new literature recently published by the manufacturer. Send for a copy to PHYSICISTS RESEARCH CO., Dept. 773, Ann Arbor, Mich., or circle **Inform-A-Gram Key No. B67.**

Get Set for Quick Set-Up!
Handy **STUD AND NUT SET**

EVERY MACHINE IN YOUR PLANT NEEDS ONE



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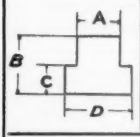
Machine Hours
Man Hours
★
Cuts Costs and Pays for Itself

40 Pieces in Each Set
All Sets in Individual Cases

Specially designed T-slot nut will prevent damage to table slots caused by ordinary nuts.



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½"—13 THD.	.555	¾"	11/32"	⅞"
⅝"—11 THD.	.675	1⅛"	15/32"	1⅛"
¾"—10 THD.	.800	1⅜"	⅝"	1⅜"

Made of Quality Steel. Case Hardened and Chrome-Plated for Long Life. Class 3 Threads. Sets Sized to Provide Greater Rigidity in Clamping.

Prices
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Order Today! Immediate Delivery!

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PRECISION EQUIPMENT FOR INSPECTION, layout, assembly and general production, is offered by The Challenge Machinery Company, Grand Haven, Michigan, in Catalog No. 836. Semi-steel checking tables, reading tables, layout plates, turntables, work benches, bench plates, and straight edges are all pictured and described as to uses and specifications. Also included are solid parallels and angle irons. THE CHALLENGE MACHINERY CO., Dept. 431, Grand Haven, Mich., or circle **Inform-A-Gram Key No. B65.**

SHORE'S STANDARD RECORDING SCLEROSCOPE for testing the hardness of metals is explained in detail in Bulletin No. SO30. Photographs and cross-sectional drawings clarify the operating instructions, which are presented in a clear and easily understood manner. The Scleroscope on its clamping stand can test sheets and flats, balls, drills, piston pins and small parts, while on its swing arm it is used for testing small and odd-shaped pieces. THE SHORE INSTRUMENT & MFG. CO., Dept. 126, Van Wyck Ave., Jamaica, N. Y., or circle **Inform-A-Gram Key No. B64.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

RYTENSE AA, a medium carbon manganese free cutting machinery steel, is described in a new bulletin published by Joseph T. Ryerson & Son, Inc. The bulletin contains figures showing strength, machinability rating, typical analysis, mechanical properties, and hardness at various tempering temperatures. Rytense AA is available in hot rolled and cold finished rounds, also forged rounds, for a wide variety of applications including shafts, and miscellaneous machinery and equipment parts. Close quality control at every step in the processing operations has produced bars free of all injurious defects. This engineering data book is available from JOSEPH T. RYERSON & SON, INC., Dept. 451, Box 8000-A, Chicago 80, Ill., or circle **Inform-A-Gram Key No. B84.**

LIMA ELECTRIC MOTORS FOR INDUSTRIAL APPLICATIONS are illustrated and described as to construction, application, size and design in a new bulletin put out by the manufacturer, Lima Electric Motor Company. Also included in the bulletin are photographs and drawings of the Lima Gearshift Drives, with detailed information regarding its design and construction. Bulletin No. MB-1 is available by writing THE LIMA ELECTRIC MOTOR CO., Dept. DC, Lima, Ohio, or circle **Inform-A-Gram Key No. B82.**

MACHINING AND REPAIRING DIESEL ENGINES with Giddings & Lewis horizontal boring, drilling and milling machines, is a colorful new bulletin recently published. Several advanced machining methods are described to illustrate the application of new tooling ideas. Case histories of successful, profit-making production of diesel engine components with the use of horizontal boring, drilling and milling machines are included. Send to GIDDINGS & LEWIS MACHINE TOOL CO., Dept. 43, Fond du Lac, Wisconsin, or circle **Inform-A-Gram Key No. B83.**

THE PALMER VERTICAL MILLING ATTACHMENT quickly and easily converts a bench lathe into a vertical milling machine. Palmer Industries, the manufacturer, has issued a bulletin describing the installation and illustrating many different applications. The Palmer vertical milling attachment clamps on the ways of the lathe and is driven by the lathe spindle through a "V" belt and adjustable pulleys. The compound of the lathe is removed and the vise slipped on in its place. It will make a cut 8" long on the longitudinal feed and 4" long on the cross feed. Stock up to 3" in diameter is easily handled. Send to PALMER INDUSTRIES, INC., Dept. 77, 6149 S. Sangamon St., Chicago 21, Ill., or circle **Inform-A-Gram Key No. B85.**

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STANDARD DIE SUPPLY, INC.....Indianapolis 4, Indiana

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PUBLICATION PREVIEWS

THE COMPLETE LINE OF INSERTED BLADE MILLING AND BORING TOOLS is offered in an attractive new catalog, No. 56, published by The Ingersoll Milling Machine Company, Rockford, Illinois. Special emphasis has been put on the new series of carbide tipped Shear Clear face mills for steel and cast iron. The catalog is divided into different sections, the first of which gives helpful advice on ordering the proper type of cutter. All of Ingersoll's cutters are clearly photographed, diagramed, and their specifications are charted. In addition, there are three pages of grinding charts. Catalog No. 56 is available at no charge by writing THE INGERSOLL MILLING MACHINE CO., Dept. 70, Rockford, Ill., or circle **Inform-A-Gram Key No. B75.**

THE SONNTAG UNIVERSAL FATIGUE MACHINES are designed for the testing of machine elements, structural components and materials, in tension, compression, bending, torsion or combined stresses. In Bulletin 258, The Baldwin Locomotive Works describe Models SF-01-U and SF-1-U. The bulletin is profusely illustrated with photographs of the machines, specimens tested on the machines, and the different fixtures used with them. Specifications are included for the different fixtures, and working instructions clarify their operation. Send for your free copy of Bulletin 258 to THE BALDWIN LOCOMOTIVE WORKS, Dept. CB, Philadelphia 42, Pa., or circle our postage-free **Inform-A-Gram Key No. B76.**

"DESIGN OF GEAR TEETH" is the subject of a new 16-page booklet published by Illinois Tool Works. This booklet was prepared especially to emphasize the design "musts" that underlie efficient gear performance. Interesting detailed information based on the long experience of Illinois Tool engineers is contained in the booklet, and for graphic explanation of the theories, detailed drawings are scattered throughout. ILLINOIS TOOL WORKS, Dept. 830, 2501 N. Keeler Ave., Chicago 39, Ill., or circle **Inform-A-Gram Key No. B80.**

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For All Finishing Operations

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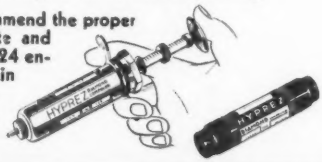
We will gladly recommend the proper grades for a complete and perfect job from our 24 engineered standards — in sealed cartridges for use with the Hyprez Applicator Gun.



HYPREZ DIVISION
ENGIS EQUIPMENT COMPANY
431 So. Dearborn St., Chicago 5, Ill., U.S.A.

TWO NEW INDIANA PRESSES, plastic forming and drawing, are now being manufactured by Indiana Foundry, Machine and Supply Company. Bulletin No. 2 describes the many new design features incorporated into the presses, one of which is the addition of a new rack and pinion on the movable platen and uprights to provide positive support and smooth, true travel alignment. Illustrations and specifications complete the bulletin. Write to INDIANA FOUNDRY, MACHINE & SUPPLY CO., INC., Dept. 22, 1400 N. Washington St., Marion, Ind., or circle **Inform-A-Gram Key No. B81.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

THE O–Z IMPROVED DIRECT READING TACHOSCOPE—a non-magnetic chronometer—is a speed indicator for accurate testing of revolutions per minute and lineal speeds in feet per minute of every type of machine. It is particularly suitable for testing high speed machines such as turbines, electric motors, gasoline engines, fans, etc. This tachoscope has a direct reading and no stop watch is needed, nor calculating. A push button control keeps the reading on the dial so that it may be read at the operator's leisure. The manufacturer, O. Zernickow Company, has issued a bulletin describing the direct reading tachoscope in detail—its working principle, range, etc. Send for a copy to O. ZERNICKOW CO., Dept. 75, 15 Park Row, New York, N. Y., or circle **Inform-A-Gram Key No. B70.**

RADII AND ANGLE DRESSERS, for modern and accurate form-dressing—known as the Fluidmotion method, are described in a new brochure issued by the J & S Tool Company, Inc. The Fluidmotion Wheel Dressers generate wheel profiles in such a way that angles and radii flow into each other, without sharp changes of direction. The result is a form that is clean, precise and entirely free of the chatter marks or tool marks caused by tension and machine vibration. J & S's different models of radii and angle dressers are photographed and their specifications and capabilities are presented in detail in the brochure. Send for your copy to J & S TOOL CO., INC., Dept. 339, East Orange, N. J., or circle our postage-free **Inform-A-Gram Key No. B71.**

"MULTI-PURPOSE" FACE PLATES are offered by Superior Manufacturing Company for converting a lathe into a milling machine, boring machine or a new drill press. In a new pamphlet, Superior Manufacturing Company explains how hours of set-up time are saved. Pictures of the face plates in operation are included in the pamphlet, as well as instructions on their use. Send to SUPERIOR MFG. CO., Dept. 74, 1302 Ontario St., Cleveland 13, Ohio, or circle **Inform-A-Gram Key No. B68.**

THE GLENNY PUSH BROACH, with adjustable expansion, is the subject of Bulletin No. 11, recently distributed by The East Shore Machine Products Company. The bulletin explains how keyways may be cut on any arbor press to an accuracy of ± .0005" without skilled labor. A new feature is the protected blade to prevent accident hazards to the user when operating stresses are applied to the tool by arbor press. Bulletin No. 11 may be had by writing THE EAST SHORE MACHINE PRODUCTS CO., Dept. 54, 835 East 140th St., Cleveland 10, Ohio, or circle **Inform-A-Gram Key No. B69.**

FROM THE MOST COMPLETE STANDARD CARBIDE TOOL LINE —
CARBIDE MILLING CUTTERS FOR EVERY JOB
SIDE MILLS 3" to 8" stocked*
SHELL END MILLS 1¼" to 6" stocked*
INSERTED BLADE FACE MILLS 4" to 14" stocked*
ROTARY BROACHES 4" to 6" stocked*
*Specify material to be machined
STANDARD AND SPECIAL SUPER Carbide Tools
SUPER TOOL COMPANY
21650 HOOVER RD. DETROIT 13, MICH. • 5218 SAN FERNANDO RD. GLENDALE 1, CAL.

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PUBLICATION PREVIEWS

COATED ABRASIVES are comprehensively covered in Behr-Manning's new Catalog No. 48. Simple and complete, this catalog was compiled for the distributor, jobber and consumer. It is arranged in nine sections which are respectively: basic information; industrial products—i.e., sheets, rolls, belts, discs, specialties; retail shelf products; floor sanding products; accessories. Profusely illustrated, the catalog (No. 48) is available by writing: BEHR-MANNING CORP., Dept. 110, Troy, N. Y., or by circling **Inform-A-Gram Key No. B1.**

ELECTRO-AUTOMATIC TOOL LIFTERS for planers and shapers are described and illustrated in a brochure recently published by Deca Company. The lifter consists of three main parts; the magnet system, the switch, and the transformer. During the return-movement of the machine, the electro-automatic tool lifter lifts the cutting tool automatically from the workpiece being machined. The four different types are fully explained and prices are given. Send for your copy of this brochure to DECA CO., Dept. 57, 4 North Avalon Rd., Great Neck, N. Y., or circle **Inform-A-Gram Key No. B4.**

PRECISION EQUIPMENT FOR ANGULAR SETUPS is Robbins Engineering Company's profusely illustrated catalog describing the Magna-Sine, a versatile magnetic chuck for all surface grinders. With Robbins' Magna-Sine only standard gage blocks are necessary to complete any setup—whether for a single or compound angle. Also described and illustrated are the Univ-Angle, and angular holding device; the Sine-Plate, a non-magnetic holding device; and the Sine-Bar for accurate angular inspection work and angular setups. Dimensions, specifications, capabilities, and working instructions are included for all the equipment. Send for your copy to ROBBINS ENGINEERING CO., Dept. 617, 318 Midland Ave., Detroit 3, Mich., or circle **Inform-A-Gram Key No. B54.**

can be done with these up-to-the minute presses. They combine modern structural design with the usual Thomas inbuilt ruggedness and dependability. Wide range of sizes and capacities. *Write for Bulletin 307.*

P-2

THOMAS
MACHINE MANUFACTURING COMPANY
PITTSBURGH 33, PA.

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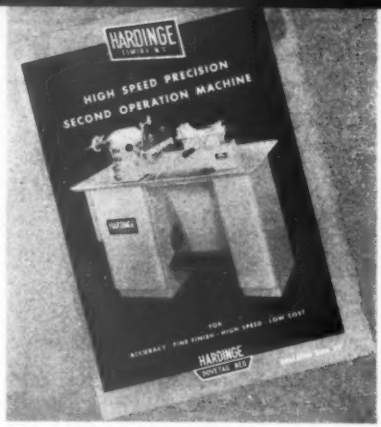
PUBLICATION PREVIEWS



HIGH SPEED PRECISION SECOND OPERATION MACHINES, all their features and specifications, are set forth in a new catalog (No. DSM 59) recently published by Hardinge Brothers, Inc., Elmira, New York. Close-up photographs of the double tool cross-slide, preloaded ball bearing turret, collet closer, self-draining oil pan and the welded steel pedestal with knee space, illustrate clearly the fine workmanship and design incorporated into the machine. Also included are photographs and descriptions of the various accessories available, with working instructions. There are drawings giving the tooling dimensions and floor plan. Send for your copy to HARDINGE BROS., INC., Dept. 582, Elmira, N. Y., or circle postage free **Inform-A-Gram Key No. B43.**

HORIZONTAL FACE GRINDERS are illustrated and their specifications are given in The Bridgeport-Diamond Machine Company's new catalog. Many illustrations demonstrate the various types and kinds of machine parts, both large and small, which are produced on these machine tools. Other illustrations show the ease and facility of operation of all controls, also the ruggedness of the face grinder. For your copy send to THE BRIDGEPORT-DIAMOND MACHINE CO., Dept. 66, 2362 Main St., Stratford, Conn., or **Inform-A-Gram Key No. B39.**

A NEW WALTHAM THREAD MILLING MACHINE BULLETIN, NO. 248, gives a comprehensive story of the machine, its capabilities, method of operation, details of construction, and specifications. The bulletin is profusely illustrated with photographs of the cutters, cutter heads of various types, front and rear and close-up views of the machine, and the various attachments available. Send for Bulletin No. 248 to the sole distributor, EDWARD BLAKE CO., Dept. 79, 437 Cherry St., West Newton 65, Mass., or circle **Inform-A-Gram Key No. B40.**

This "*Minute Man*"®
KIT OF FINE TOOLS

SAVES YOU MINUTES AND MONEY

HERE'S HOW IT WORKS

You simply drop the right size bushing in the bore, insert the precision broach and press it through, using a shim and second pass to get the exact depth. In sixty seconds you have a clean, accurate keyway in any gear, pulley hub, coupling, collar, milling cutter or what have you. *Are You Willing To Be Shown?*

Ask your *Industrial Distributor* to show you the du MONT Minute Man Keyway Broach Kit in its handsome hardwood case, or

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Please mail me the *Minute Man* Manual X containing complete information, prices and valuable reference data.

Name ..... Position .....

Company .....

Address .....

The du MONT CORPORATION
GREENFIELD, MASSACHUSETTS

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PUBLICATION PREVIEWS

A ONE-SOURCE GRINDING SERVICE for many diversified operations is now possible through the addition of a new line of resin-bonded wheels by Robertson Manufacturing Company, Trenton, N. J., to its vitrified-bonded line. Literature is available from Robertson describing this service in detail and the new resin-bonded wheels. Also included are grinding recommendations for all types of material. Send for literature to ROBERTSON MFG. CO., Dept. 89, Morrisville, Pa., or circle **Inform-A-Gram Key No. B34.**

PROSSER CARBIDE TOOL GRINDERS for high speed steel, stellite, and other modern cutting tools, as well as carbide, are illustrated and detailed in a colorful brochure recently published by Thomas Prosser & Son, New York. Several different models, both bench and floor type, are described, their dimensions given, and design and construction features. Also included are descriptions and illustrations of accessories for the machines, as well as a complete price list of all Prosser's grinders. Send for your copy of brochure to THOMAS PROSSER & SON, Dept. 433, 120 Wall St., New York, N. Y., or circle **Inform-A-Gram Key No. B35.**

BALAS COLLETS ARE CAM GROUND on the taper to a "cloverleaf" shape. The many advantages of this improved shape are explained and illustrated in Balas Collet Manufacturing Company's new Catalog No. 48. The various models are shown and detailed in this 14-page color catalog which also includes a complete price list. Send for your copy to BALAS COLLET MFG. CO., Dept. J, 3802 Woodland Ave., Cleveland 15, Ohio, or circle **Inform-A-Gram Key No. B36.**

Save many man hours, conserve valuable tools and dies and minimize production delays with the aid of EUREKA TOOL and DIE WELDING ELECTRODES. Here's how it can be done:

1 REPAIRING DIES. . . . Existing units that may fail in operation can be EUREKA welded, either partially or wholly, resulting in a minimum of "down-time."

2 COMPOSITE FABRICATING. . . . Die units can be compositely fabricated, when practical, by EUREKA welding, resulting in numerous advantages.

3 CORRECTING DESIGN. . . . EUREKA welding facilitates making changes in contour, corners or edges during die "try-out" or "change-over" periods.

4 RECTIFYING ERRORS. . . . EUREKA welding permits the correction of errors made in tool and die manufacturing, resulting in great savings. *Write for Literature*

WELDING EQUIPMENT & SUPPLY CO.
225 LEIB STREET • DETROIT 7, MICHIGAN

ELECTROLIMIT INTERNAL COMPARATORS are precision measuring instruments designed to gage the internal diameters of parts accurately and rapidly. An attractive, profusely illustrated brochure (No. 497) is available from the manufacturer, Pratt & Whitney, which describes these comparators in detail. Several standard models are presented. Photographs show various job applications of each model, and lucid copy gives all the operating and construction details. All of these comparators use the same basic electrolimit principle—mechanical gaging in combination with electrical magnification. For Catalog No. 497 circle **Inform-A-Gram Key No. B32.**

PRATT & WHITNEY SUPERMICROMETER is dramatically portrayed in another illustrated brochure (No. 499). The Supermicrometer is a compact precision measuring instrument which measures directly to one ten-thousandth of an inch. Send for your copy to PRATT & WHITNEY, Dept. 430, West Hartford 1, Conn., or circle **Inform-A-Gram Key No. B33.**

PLEASE USE INFORM-A-GRAM FOR PRODUCT INFORMATION

Predictable Castings Produced for Machining

It's surprising to learn how many manufacturers are looking for sound, accurate, predictable ferrous castings Everywhere we go to talk about *Strenes Metal* cast dies, we are asked if we do the same quality of work in alloy gray iron and gray iron When we answer yes, we are given a lot of jobs for machine beds, bases, columns, and other items which require good castings, and our customers keep coming back for more.

As everyone knows, it pays to go far, if necessary, to get close-grained castings free of porosity, cold shuts, blowholes, inclusions, and other defects revealed by machining. The extra transportation cost is insignificant compared to the reduction of tooling expense and avoidance of scrap.

If you have been unsuccessful in getting predictable castings for machining, communicate with us.

Write, phone, or wire.

THE ADVANCE FOUNDRY COMPANY Dayton 3, Ohio

ADVANCE CASTINGS

STRENES METAL
ALLOY GRAY IRON
GRAY IRON

FOR MAXIMUM
IN DRILLING
"...it's the bushing that makes the wHOLE difference"
To maintain maximum accuracy in drilling operations, use the bushing that's precision made for the job . . . use Acme! Write for catalog.
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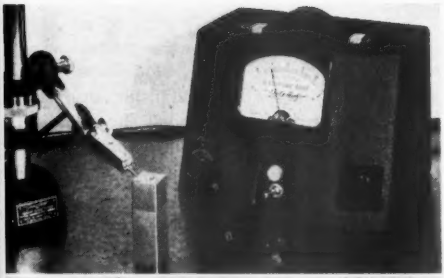
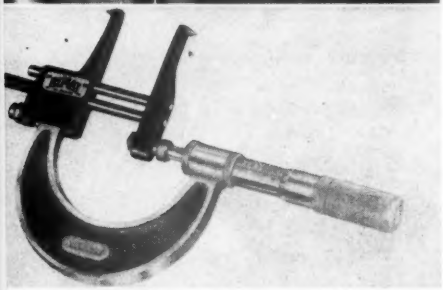
Interchangeable
Concentric
Acme Industrial Company
Makers of Hardened and Ground Precision Parts
206 N. LAFLIN STREET • CHICAGO 7, ILLINOIS
THE SERVICE SHOP TO INDUSTRY FOR MORE THAN 25 YEARS

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

PROGRESS

NEW DEVELOPMENTS • IMPROVEMENTS • COST AND TIME SAVERS





CIRCLE KEY NUMBERS ON POSTAGE-FREE INFORM-A-GRAM INSERT FOR FURTHER INFORMATION

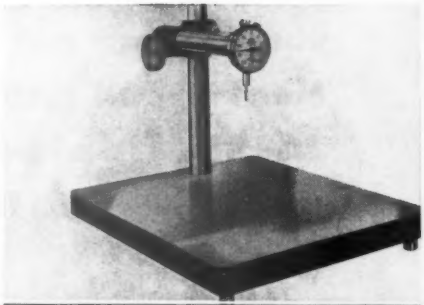
THE MERZ NEW-TRONIC HEIGHT GAGE. shown at left, is furnished complete with stand and is one of the three new types of New-Tronic equipment recently acquired by Merz Engineering Company, Indianapolis, from Jack & Heintz. The stand has fine-adjustment for speed and efficiency in operation. It may be used as a height gage, a comparator, for checking concentricity or set-ups on machine tools, etc. Further details from MERZ ENGINEERING CO., Dept. 720, 200 S. Harding St., Indianapolis 7, Ind., or circle **Inform-A-Gram Key No. A14.**

THE RIMAT MICRODAPTER is an attachment, developed by the Richards Machine Tool Company for outside micrometers, which makes possible the measuring of internal dimensions. Internal measurements can be taken with speed and accuracy. The Microdapter is just as accurate as the micrometer to which it is attached. Easily installed, it may be removed or installed in less than one minute. The measuring tips are bright, hardened tool steel. This is an inexpensive tool much needed by toolmakers and machinists. Further details from RICHARDS MACHINE TOOL CO., Dept. 26, 124 South Isabel St., Glendale 5, Calif., or circle **Inform-A-Gram Key No. A15.**

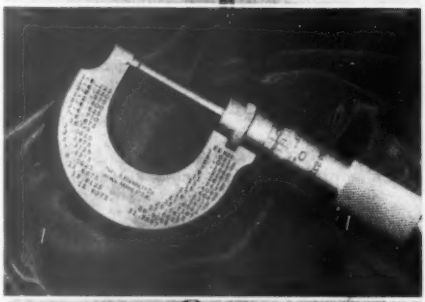
THE METRON COMPARATOR GAGE. illustrated at left, has four ranges of magnification which are selected by means of range switches; thus the gage can be used for a wide variety of gaging applications—from checking gage blocks to production inspection of machined parts. Three models are available, with ranges of 1 millionth inch to 4 ten-thousandths inches; 10 millionths inch to 5 thousandths inches; and ½ a ten-thousandth inch to 20 thousandths inches. The spindle pressure is adjustable and calibrated from 4 ounces to 2½ pounds, and the head can be rotated at any angle about the column or in the vertical plane for versatile application. There are only two moving parts on the gage—the spindle, which is supported in flexure, and the pointer, which is mounted on jewel pivots. Full particulars from METRON INSTRUMENT CO., Dept. 391, 432 Lincoln St., Denver, Colo., or circle **Inform-A-Gram Key No. A16.**

ON PARADE

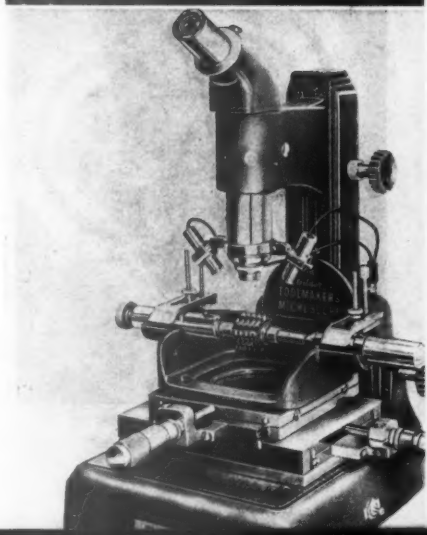
AMES HEAVY-DUTY DIAL COMPARATOR was designed by B. C. Ames Company to provide a larger-size precision comparator of wide range and utility. This No. 130 is especially suitable for applications requiring the checking of comparatively heavy parts such as large diameter shafts, solid blocks having large cross-sections, etc. Because of its rigid construction, it is also extremely accurate for general dimension checking on light-weight parts. The base is solid 1" thick steel, with the top fine-finish ground to a close-tolerance flatness. Three-button support of the base eliminates rocking of the Comparator on the bench. The indicator usually furnished is Ames Model No. 202 with lift lever, although any size or range can be supplied. B. C. AMES CO., Dept. 189, Waltham 54, Mass., or circle **Inform-A-Gram Key No. A17.**



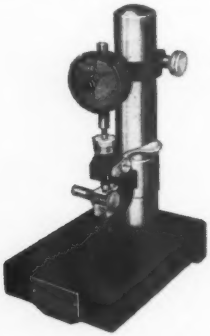
NON-REFLECTING "SATIN CHROME" MICROMETERS have been announced recently by The L. S. Starrett Company. The "Satin Chrome" finish is produced by a special process which results in a glare-free non-reflecting surface against which markings and graduations stand out sharp and clear under any illumination. The glare and dark shadows which make reading difficult on the ordinarily bright finished micrometers is eliminated. This "Satin Chrome" finish is also more resistant to stains and corrosion. For further details write THE L. S. STARRETT CO., Dept. 699, 121 Crescent St., Athol, Mass., or circle **Inform-A-Gram Key No. A18.**



A LOW-PRICED TOOLMAKERS' MICROSCOPE has been placed on the market by the George Scherr Company, Inc., which incorporates the essential features and characteristics for extreme accuracy. This Wilder microscope has a heavy Meehanite base and post on which the Meehanite microscope bracket is vertically adjustable by spiral rack and pinion. The microscope tube has a standard magnification of 30× for the image of the work. The standard reticule in the eyepiece contains a 90° hairline cross and a 60° angle cross for thread measurements. Measurements in two directions are by 1" heavy type micrometer screws of dull chromium finish that read directly in .0005". There is understage illumination for shadow images and surface illumination for reflected images. Full details and brochure available from GEORGE SCHERR CO., INC., Dept. 490, 200 Lafayette St., New York 12, N. Y., or circle **Inform-A-Gram Key No. A19.**



THE SWANSON THREAD COMPARATOR, an instrument for accurate, inexpensive thread checking is available now for use in plants as well as critical aircraft work. Production time, precision inspection time and maintenance cost of gages are drastically



reduced. The Swanson comparator consists of a stand with indicator and standard thread unit. The indicator records the work visually to accepted ring gage tolerances. Further information from THE NATIONAL AUTOMATIC PRODUCTS CO., Dept. 68, 23 Whiting St., New Britain, Conn., or circle **Inform-A-Gram Key No. A6.**

ELECTRIC HAND TACHOMETERS with multiple range are now being manufactured at Metron Instrument Company. They are available in either revolutions per minute or feet per minute and have an accuracy of 1 percent. Three separate ranges are provided on a 100 division, 3⅛ inch scale. The desired range is selected by means of a simple switch. The tachometer head is connected to the indicator with an electric cable—thus readings are steady. For further details write METRON INSTRUMENT CO., Dept. 391, 432 Lincoln St., Denver 9, Colo., or circle **Inform-A-Gram Key No. A22.**

THE ELECTROSIZER GAGE is an automatic grinding size gage. When mounted on an external cylindrical grinding machine, it functions to back the grinding wheel away from the workpiece automatically when the diameter being ground is correct to within .00005". The gage closes an electric circuit which controls the hydraulic operation of the grinding wheel slide. This may be done with the controls built into the grinding machine or by means of control mechanism furnished by the

gage manufacturer. The Electrosizer Gage is built to a high standard of design and performance. It is of rugged, accurate construction, with fully interchangeable parts. The gage is equipped with tungsten carbide wear points. Diamond gaging points are available as an extra. Detailed and illustrated specifications, construction descriptions and installation instructions are available on request from FOSTER ENGINEERING COMPANY, Dept. 98, 4200 Woodward Ave., Royal Oak, Michigan, or by use of our postage-free **Inform-A-Gram Key No. A26.**

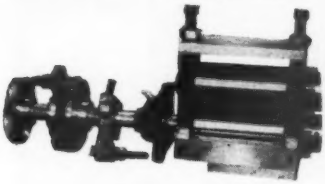
1 ton radial loads can't budge tools gripped in UNIVERSAL COLLET CHUCKS

UNIVERSAL ENGINEERING CO.
FRANKENMUTH 8, MICHIGAN

DURANT

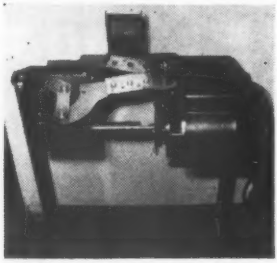
EQUIPMENT for the MODERN PRESS ROOM

Some Dealer Territories Still Open
Write for Details



UNIVERSAL ROLL FEEDS

Available in a wide variety of sizes to meet all power press requirements. Friction type — accurate — easily adjustable. $125 up.



AUTOMATIC SCRAP CHOPPER

Independent unit that can be used with any power press. In two sizes — will handle from 4" wide material up to $\frac{1}{16}$" thick. $187.50 and $199.50.

STOCK OILER

Cleans and lubricates all material up to 6" wide. Inexpensive, effective, convenient. $38.00.

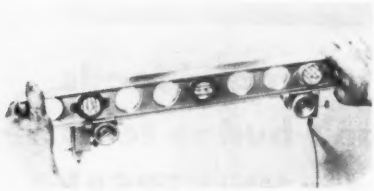
WRITE FOR COMPLETE INFORMATION

DURANT TOOL SUPPLY CO.

155 Orange Street — Providence 3, R. I.

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

TRAMMEL POINTS FOR SCHULTES LEVELS are now available, according to the manufacturer, Schultes Level, Inc. These trammel points are particularly useful in laying out circles, spacing of holes around the circle, and spacing two-by-fours or joists. Draftsmen will find it an excellent substitute for a beam

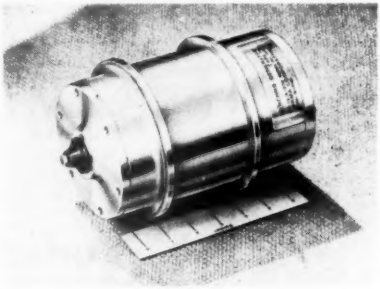


compass for making larger drawings. Further details from SCHULTES LEVEL, INC., Dept. 67, 17403 Gable, Detroit 12, Mich., or circle **Inform-A-Gram Key No. A2.**

FOR CHECKING OUT-OF-ROUNDNESS AND DIAMETERS of cylindrical parts, Swedish Gage Company of America has developed the Ridermikrokator. Centerless-ground pieces may also be checked. Hardened, ground and lapped anvils form a 60° angle.

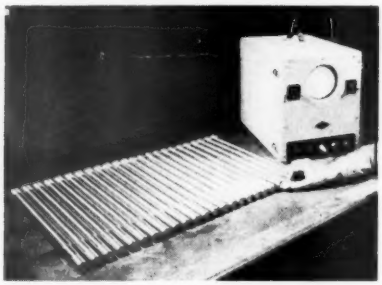
Thus the difference in radius between the setting gage and work is measured, and the tolerance pointers of the mikrokator should therefore be positioned only to half the limits required. The measuring instrument is a standard mikrokator No. 220 which is locked in the frames by a screw. Further details available from SWEDISH GAGE COMPANY OF AMERICA, Dept. 85, 8900 Alpine Ave., Detroit 4, Mich., or circle **Inform-A-Gram Key No. A7.**

ARMA SYNCHRO UNITS afford a complete line of reliable, accurate self-synchronous units for remote control and indicating purposes. They are particularly adaptable for



electronic and electrohydraulic control systems. The free rotor units are highly accurate and well-damped and may be used as remote indicators or repeaters. The line includes Control Transformers, Motors, Generators, Differential Motors and Differential Generators. Further details and a catalog illustrated with outline drawings and photographs are available from ARMA CORP., Dept. 79, 256 36th St., Brooklyn 32, N. Y., or circle **Inform-A-Gram Key No. A13.**

FOR NON-DESTRUCTIVE TESTING OF METALS for internal defects, Sperry Products, Inc., are producing a new Supersonic Reflectoscope, Type SR05. The machine will also test welds. This redesigned Model SR05 is compact, handy, light of weight, and is easily handled. With the five external controls, the operator can vary sensitivity, pulse width,



sweep length, screen markers and frequency. Because of its portability, it is particularly adapted for field testing in tanks, pipes and plant equipment. Further details from SPERRY PRODUCTS, INC., Dept. 85, 1505 Willow Ave., Hoboken, N. J., or circle **Inform-A-Gram Key No. A1.**

Quality Lathe Dogs

Heavy malleable iron. Tail fits face plate slot. Standard Dog has square head screw. Safety Dog has headless screw. Prices are for either style.

	Capacity	Price*	Capacity	Price* *
STANDARD	1/2"	$0.85	3/8"	$0.75
	3/4	1.00	1/2	.80
	1	1.10	3/4	.95
	1-1/4	1.25	1	1.05
	1-1/2	1.50	1-1/4	1.15
	1-3/4	1.65	1-1/2	1.45
	2	1.80		
	2-1/2	2.05		
	3	2.30		
	3-1/2	3.15		
	4	4.25		

* 13-inch or larger lathes.
* * 9-inch and 10-inch lathes.
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● Established over a half-century ago to design and build fine surveying instruments *that had to be accurate*, The J. C. Ulmer Company has always made precision a *habit*.

Today this Ulmer habit of Precision Service is paying dividends to many of the outstanding industrial plants of America in the unsurpassed performance of their Ulmer-built tools, gages, jigs, fixtures and special machines.

Write today for our new folder, "Precision Service,"

THE J. C. ULMER COMPANY
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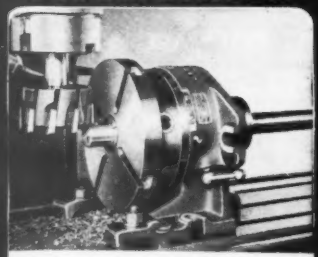
1791 East 38th Street • Cleveland 14, Ohio

SUPER-SPACER



For MILLING

The uses of the Super-Spacer in horizontal and vertical milling operations are unlimited. Here the Super-Spacer, mounted with a face plate and draw-in collet combination, shows its adaptability for milling bar stock. Investigate your present milling methods and see if your shop can't profit by the speed and accuracy of the Super-Spacer. For complete details write Dept. 85.

HARTFORD *Special*

THE HARTFORD SPECIAL MACHINERY CO.
HARTFORD 5, CONN.

Motorized HOPPER UNITS

Speedy Sturdy Dependable

FASTEST FEED ● STURDY WIDELY ADAPTABLE

For use with Presses, Centerless Grinders, Thread Rolling and Slotting Machines, or any special machine.

SUCCESSFULLY FEED:

SCREWS, SCREW BLANKS, RIVETS, PINS, DISCS, NUTS, BEARING ROLLERS, STEEL BALLS, WASHERS, ALSO MISCELLANEOUS ITEMS, SUCH AS SCREW MACHINE PARTS, STAMPINGS, ETC.

Send Samples for Detailed Information

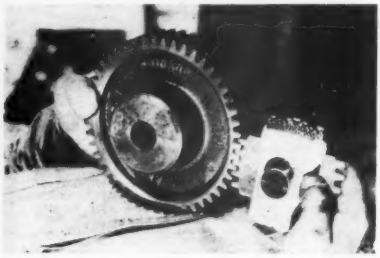
Write for Catalog

DETROIT POWER SCREWDRIVER CO.
2827 West Fort Street, Detroit 16 • Michigan

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

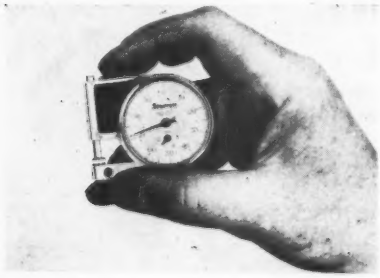
PROGRESS ON PARADE

A NEW STAINLESS STEEL GEAR GAGE has been added to George Scherr Company's line of gear testing equipment. Previously available only in 14½° pressure angle, the stainless steel gear gage is now made with 20° pressure angle full length tooth form 3–4–5–6–8–10–12–16–20–24–32–48 and stub tooth forms 3/4 – 4/5 – 5/7 – 6/8 – 8/10 – 10/12 – 12/14 – 16/21 – 20/26 – 24/32 – 48/64.



Quickly and simply operated, the gage is merely rolled over the teeth of the gear and one can tell the pitch instantly without chance of error. Further details from GEORGE SCHERR CO., INC., Dept. 490, 200 Lafayette St., New York 12, N. Y., or circle **Inform-A-Gram Key No. A27.**

THE VEST POCKET DIE INDICATOR, illustrated below, is no bigger than a thin pocket watch. It was developed by the L. S. Starrett Company for quick and easy measuring and comparing thicknesses of paper, leather, rubber, sheet metal, wire, plastics, etc. The large easily read dial is graduated to read in thousandths of an inch, and a small "tell tale" hand counts revolutions of the larger hand up to the maximum range of ⅜ inch.

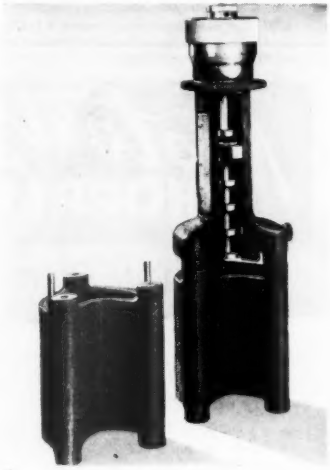


The gage is precision made and encased in a chrome plated case, with an unbreakable crystal. Complete details from THE L. S. STARRETT CO., Dept. 699, Athol, Mass., or circle **Inform-A-Gram Key No. A29.**

A POCKET-SIZE MICROSCOPE, precision made with all the advantages of a laboratory instrument, has been introduced by Buhl Optical Company, Pittsburgh. It is equipped with fully corrected achromatic lenses render-

ing well defined images. The power is 40x when closed, 50x and 60x when set to markings by adjusting the tube. Finished in brass and chrome, it is enclosed in a handy leather case. For full information write BUHL OPTICAL CO., Dept. 69, 1009 Beech Ave., Pittsburgh 12, Pa., or circle **Inform-A-Gram Key No. A10.**

6" PLA-CHEK GAGE is a new portable gage designed for the checking of smaller jobs—such as checking gages, tool and dies



on the surface plots or at the machine. It is completely self-contained, simple to use, and accurate to .00005". It may be used on larger jobs with the addition of 6-inch risers shown in the illustration above. Literature and full particulars are available by writing CADILLAC GAGE CO., Dept. 61, 20315 Hoover Road, Detroit 5, Mich., or circle **Inform-A-Gram No. A21.**

MIRROR FINISHES
in Minutes instead of Hours

On Tungsten Carbide, Tool Steels, Special Steels, Chrome, etc.

WITH STAR DUST

Laboratory Graded

Pure Diamond Powders and Diamond LAPPING COMPOUND

Produces super-finishes and polishes down to less than a MICRO-INCH with INCREDIBLE SPEED.

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35 YEARS OF DIE SET MAKING

THE DIE-SET AUTHORITY

All Baumbach Die-Sets have demountable Leader Pins and Bushings. This exclusive feature permits removing leader pins for machine work on the die shoe and assures reassembly without loss of alignment. A big time and trouble saver. Write for Catalog.

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SPEED- DIE AND MOLD FINISHING

THE haskins WAY!

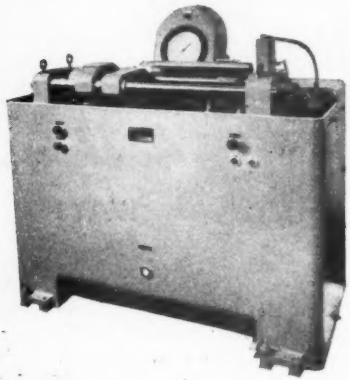
★and that's with Haskins Flexible Shaft Machines. Designed to speed die and mold finishing, Haskins HS-4 equipment—½ H.P. — has a six-speed, Timken-bearing countershaft that develops up to 7800 R.P.M. Pedestal mounted at bench height, this portable machine delivers the constant power needed for continuous production. Haskins has a complete line of attachments, too, for all grinding, sanding, filing or polishing operations. For instance, a true running taper shank spindle extension makes it possible to get down into deep cavities. Write today for full information. **R. G. Haskins, 2651 W. Harrison St., Chicago 12, Illinois.**

Haskins Type HS-4 equipment in die finishing service

HASKINS
haskins
FLEXIBLE SHAFT EQUIPMENT

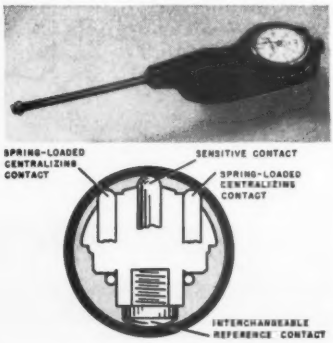
SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

FOR PRESSURE TESTING OF TUBING, Steel City Testing Machines, Inc., has designed a Hydrostatic testing machine for pressures up to 20,000 pounds per square inch. The machine seals the end of the tubing without any perceptible flare, eliminates air, and builds up to the required pressure. It holds this pressure for a predetermined amount of time then automatically reverses and is ready for

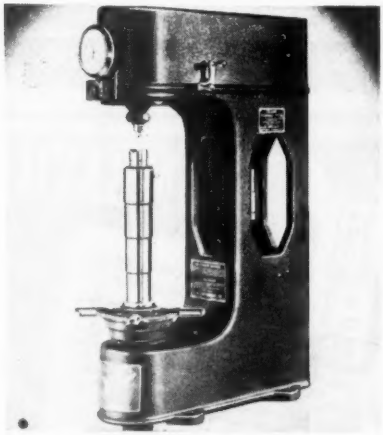


the next test. The entire time cycle—load and unload—is only four seconds. The pressure gage may be disconnected during the test and the peak test pressure is shown by a red light on the panel. Further details from STEEL CITY TESTING MACHINES, INC., Dept. 79, 8843 Livernois Ave., Detroit 4, Mich., or circle **Inform-A-Gram Key No. A23.**

SELF-CENTRALIZING HOLE GAGE, which shows size variations in tenths of thousandths and which employs fourteen interchangeable extensions to cover the full range from ¼" to ½" diameter readings, is manufactured by Federal Products Corp. The spring-centralizing design of this gage, plus the precise measuring contacts and motion transfer units, locate themselves in the hole and show the true diameter reading accurately. The gage also explores any hole within its capacity to a maximum depth of 2¼", revealing diameter, roundness, taper, bellmouth and other hole inaccuracies. Further details may be obtained by writing FEDERAL PRODUCTS CORP., Dept. 4, 1144 Eddy Rd., Providence, R. I., or circle **Inform-A-Gram Key No. A20.**



SUPERFICIAL HARDNESS TESTER FOR "ROCKWELL" TESTING is designed by Clark Instrument, Inc., Dearborn, Michigan, for testing surfaces that must not be marred. This Clark Superficial has a depth of penetration held to limits of .005" or less and is particularly suitable for testing surface hardened steel, very thin metals, rolled sheet metal, or



very small areas. It may also be used for standard "Rockwell" testing of metals that are of uniform hardness throughout, or wherever a test of surface hardness only is needed. Standard equipment includes specially formed and lapped diamond cone penetrator; $\frac{1}{16}$" steel ball penetrator; telescoping cover for elevating screw; oil reservoir for elevating screw; 3½" anvil, checking anvil, and "V" anvil. This new tester comes completely equipped in three models: 8", 12", or 16" vertical capacity. Full details may be obtained by writing CLARK INSTRUMENT INC., Dept. 120, 10200 Ford Rd., Dearborn, Mich. **Inform-A-Gram Key No. A83.**

LOUIS B. KOLB
Director

DEPENDABLE
Since 1932

AMERICAN PERSONNEL BUREAU

"EXECUTIVE AND SUPERVISORY PERSONNEL"

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ADVERTISING SALES
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PENOBSCOT BLDG.
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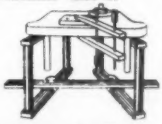
NEW ACRO SAFETY PARALLEL UNIT

A low price indispensable tool for all Tool and Die Departments—Machine Shops.



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- QUICK ADJUSTMENT
- 20" ADJ. SPREAD
- 3", 5", 7", HEIGHTS
- HARDENED
- PRECISION GROUND

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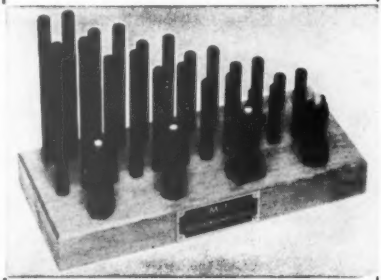
M-T **41 PIECE SET-UP STUD and NUT SET**

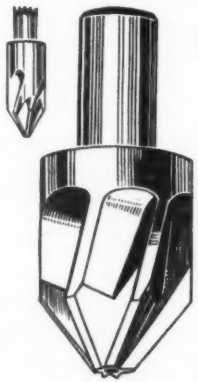


AT YOUR FINGERTIPS
WHEN YOU WANT THEM
TOUGH — THEY CAN TAKE IT

½" Set	$21.00
⅝" Set	23.00
¾" Set	26.00

Standard equipment for every machine tool.
F.O.B., Ferndale . . . Immediate Delivery
Write for catalog and templates on M-T Fixture Clamps and Components.

MORTON MACHINE WORKS
2423 Wolcott Detroit 20, Mich.



CHATTERLESS COUNTERSINKS

HIGH SPEED STEEL AND CARBIDE

HEAVY DUTY
17 SIZES IN 3 ANGLES EACH

(OTHER ANGLES FROM STOCK BLANKS)

CHATTERLESS BALL SEAT REAMERS

8 SIZES IN STOCK

2 LIP
BALL NOSE
DRILLS
12 SIZES

ANGLES 30°, 41°, 45° STOCKED IN 12 STANDARD SIZES, HIGH SPEED STEEL AND CARBIDE

WRITE FOR BULLETIN NO. 15-C

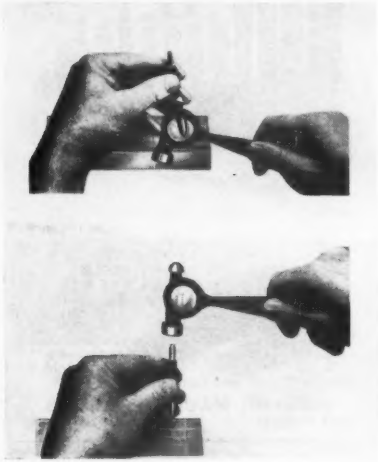
FOR USE IN DRILL PRESSES TURRET LATHES AND SCREW MACHINES

SEVERANCE TOOL INDUSTRIES INC.
730 IOWA STREET
SAGINAW, • MICHIGAN

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

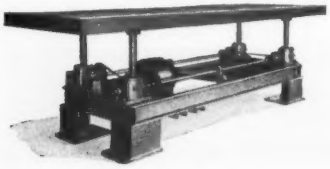
PROGRESS ON PARADE

THE BUILT-IN MAGNIFIER ON DIE MACHINE HAMMER, shown below, assures accurate spotting and punching of center lines and intersections. This unique tool, developed by The L. S. Starrett Company, is made from a steel forging with flat and ball peen heads



and weighs only 4 ounces. The 7-power lens is built into the head of the hammer and makes it possible to spot and strike a punch without once removing the eyes from the work. Further details from THE L. S. STARRETT COMPANY, Dept. 699, Athol, Mass., or circle **Inform-A-Gram Key No. A30.**

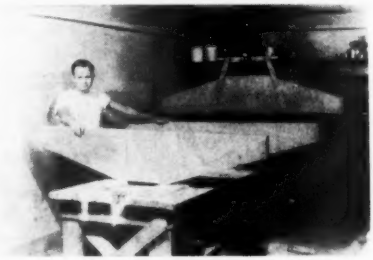
AN AUTOMATIC STACK LIFTER, for preventing damage to sheet metal and for stopping the "muscle" labor involved in dragging large sheets from a pile to machine positions, is being manufactured by The Hamilton Tool Co. Push button controlled, and powered by a 5 hp high torque motor, the table levels its load to the shear machine bed, allowing a one-man operation of easily sliding the sheets into position. A continuous lift rate device is available for automatic starting and stopping, thus keeping the sheets at a predetermined level while they are being used. These lifters can also be used to great advantage as dock lifters for loading and unloading trucks. THE HAMILTON TOOL CO., 832 So. Ninth St., Hamilton, Ohio. **Inform-A-Gram Key No. A91.**



TEMPILSTIKS° ARE TEMPERATURE INDICATING CRAYONS for controlling temperatures where the workpiece is under observation. They cover 47 specified temperatures in the range from 125° to 1600° F. The technique is simple. The hot workpiece is touched or stroked from time to time with the proper Tempilstik°. As long as the workpiece is below the temperature rating of the Tempilstik° selected, the latter will leave a chalky

or dry mark. However, as soon as the workpiece reaches the temperature rating of the Tempilstik° used, the latter will leave a liquid streak on contact with the hot surface. Further details from TEMPIL° CORP., Dept. 71, 132 W. 22nd St., New York 11, N. Y., or circle **Inform-A-Gram Key No. A28.**

GRANITE STRAIGHT EDGES are made by Rahn Granite Surface Plate Company to a tolerance of .00005". Illustrated below are three 6 foot long granite straight edges. They will not warp due to temperature changes



or shock; they will not rust, so require no oiling and cleaning; they are harder than tool steel and show no wear. Should they be accidentally nicked, the granite merely crumbles a little and no compensative hump rises. Further details available by writing RAHN GRANITE SURFACE PLATE CO., Dept. 63, 1149 Plott Circle, Dayton 7, Ohio, or circle our postage-free **Inform-A-Gram Key No. A31.**

Why a *Commander* Tapper?

- **Tapping capacity** 0 to ¾" with **one** tapper.
- **Torque control**—may be adjusted to protect any size tap. This assures safe bottom-hole tapping.
- **Spring clutch** drive eliminates slippage and wear . . . provides smooth, quiet, positive operation.
- **Compactly built**—affords maximum visibility of tapping operation.
- Furnished to fit **any** Drill Press.

See Us in Booth 941 at the Metal Show, Philadelphia, October 25-29

One COMMANDER TAPPER handles the range #0 to ¾"

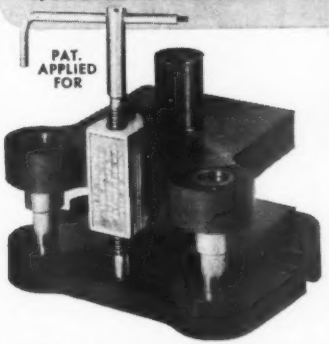
Write for circular and name of your nearest Distributor.

COMMANDER MFG. CO.
4228½ W. Kinzie Street Chicago 24, Ill.

Product of *Commander* . . . Builder of the *Multi-Drill*

DIE SETS SEPARATED AND ASSEMBLED QUICKLY...EASILY...SAFELY...WITH THE NEW

PERSSON DIE JACKS



Eliminate old-fashioned, unsafe prying or hammering methods in your shop. Just clamp on punch holder and turn handle. Punch holder is raised or lowered smoothly - always under control. Die Jacks are made from fine steel and alloys. They are precision built tools every tool maker will want for his tool box or bench drawer.

NO PRYING OR HAMMERING — EASY DOES IT EVERYTIME!

A few good territories still open for representation. Write for details and literature.

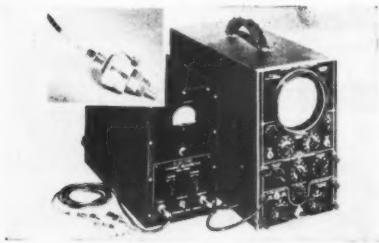
T. G. PERSSON MFG. CO., 224 GLENWOOD AVE., BLOOMFIELD 4, N. J.

SEE ADVERTISERS INDEX, PAGE 99, FOR KEY NUMBERS

MULTIPLE SEQUENCE PREDETERMINED ELECTRONIC COUNTERS, for the control of any machine or process which now requires cams, gears, patterns, chain or other systems for timing control, are produced by Potter Instrument Company, Inc., Flushing, New York. These instruments can predetermine

any number of selected counts occurring in sequence. At the completion of each of the selected counts a separate relay action is provided for each control function. The counter shown in the photograph will predetermine three different counts in sequence of any number from 1 to 10,000. For full particulars write POTTER INSTRUMENT CO., INC., Dept. 56, 136-56 Roosevelt Ave., Flushing, N. Y., or circle **Inform-A-Gram Key No. A3.**

AN ELECTRO DYNAMIC MICROMETER, which will measure movement, radial displacement or vibration of any part made of ferrous metal, has been announced by Electro Products Laboratories, Inc., Chicago. The device was designed to be used with the DuMont Model 208 oscillograph or its equivalent. The Dynamic Micrometer does not touch the moving part, and therefore does not interfere with its movement. The displacement is easily read in tenths of a thousandth of an inch with accuracy equal to a standard micrometer. The accuracy is the same for a static condition as for a dynamic condition extending over 200,000 rpm. Further details may be obtained by writing ELECTRO PRODUCTS LABORATORIES, INC., Dept. 70, 549 W. Randolph St., Chicago 6, Ill., or by circling **Inform-A-Gram Key No. A12.**



TWO IMPROVED DIAMOND PENETRATORS for "Rockwell" testing have been announced by Clark Instrument, Inc. These Clark diamond penetrators have diamond points carefully selected for proper stratification and freedom from internal stresses, and

provide accurate results. The "S" will fit all machines for superficial "Rockwell" testing; and the "C" model fits all machines for standard "Rockwell" testing. Further details may be had by writing to CLARK INSTRUMENT CO., INC., Dept. 120, 10200 Ford Rd., Dearborn, Mich., or circle **Inform-A-Gram Key No. A8.**

Adjustable Collet Bushing Chuck—

provides an accurate method for mounting centerless armature shafts and similar parts in a lathe. Use in either head or tail spindle. The brass collets are adjustable for running or driving fits. Chucks supplied with 3 collets; 9/16", 5/8", and .637" capacity. Extra round collets, 1/4" to 1" by 16ths, $1.10 each.

Chuck with No. 2 shank . . . $9.45
Chuck with No. 3 shank . . . $9.95
f. o. b. factory

SOUTH BEND LATHE WORKS
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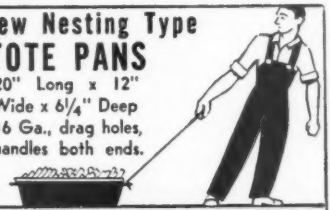

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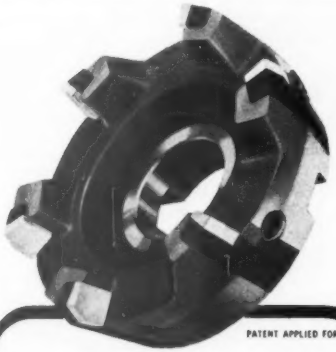

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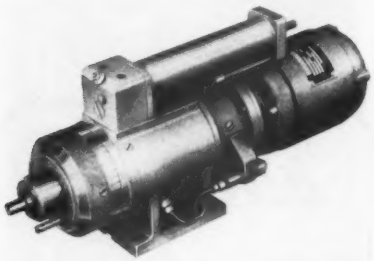
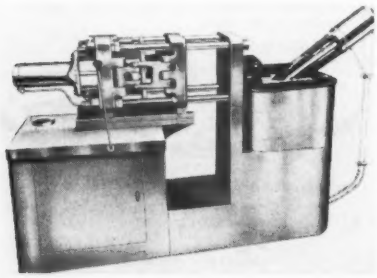


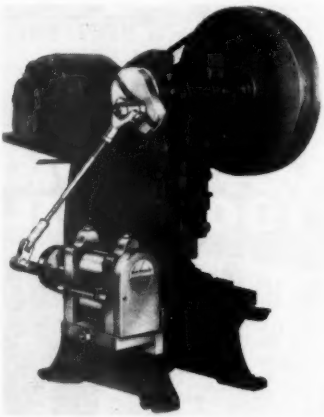
single and multiple units feature a patented rapid approach and variable feed which allows rapid approach of drill to within .001" of the work. At this point, the work feed cuts in automatically. The cutover is accomplished smoothly and without hesitation. Controlled depth of drilling, countersinking and chamfering can be held to tolerances of .001" by means of a micrometer adjustment on spindle travel. All working parts are entirely enclosed, eliminating danger of damage from entry of chip, dirt, or coolant. Units can be provided with hand, foot, semi-automatic or fully automatic controls. CLEVELAND REPUBLIC TOOL CORP., Dept. 69, 1265 Union Commerce Bldg., Cleveland 14, Ohio. **Inform-A-Gram Key No. A54.**

AN ALL-HYDRAULIC HOT CHAMBER DIE CASTING MACHINE is now being manufactured by Production Engineering Consultants. It embodies cold chamber injection pressure



for a two-pound shot, either center gated or three inches below. This machine is built to take die thicknesses from six inches to eleven inches, with die half separation of six inches. Safety and ease of operation are major features of this machine. It cannot be shot when the dies are open and uses non-flammable oil which is furnished as standard equipment. The high platen center line of 38 inches reduces operator fatigue. Casting operation is by a single lever control which, when moved forward, closes the die and shoots. The backward movement of the lever opens the machine and ejects the casting. PRODUCTION ENGINEERING CONSULTANTS, Dept. 21, 3771 Edgehill Drive, Los Angeles 16, Calif. **Inform-A-Gram Key No. A52.**

NEW AUTOMATIC FRICTION ROLL FEED FOR PRESSES, which may be used on most standard presses and all Benchmaster presses, has been designed by Benchmaster Mfg. Co., Los Angeles. It can be used with metal,



wood, plastic, cardboard and felt. Among its outstanding features are its ability to take stock up to 3" in width; its full speed of 285 fpm per minute; its easily reversible rollers; the adjustable brake; and the friction drive which is geared down to give 0 to 3" adjustment in feed — with a longer feed obtainable. The rollers and friction roll are hardened and ground and the bearings are bronze to protect all wear points. Price and detailed information can be obtained from BENCHMASTER MFG. CO., Dept. 169, 2952 West Pico Blvd., Los Angeles 6, Calif., or circle **Inform-A-Gram Key No. A49.**

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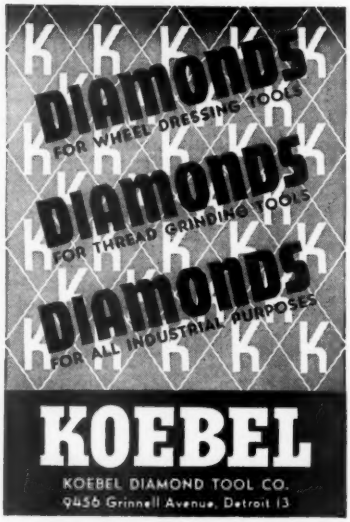

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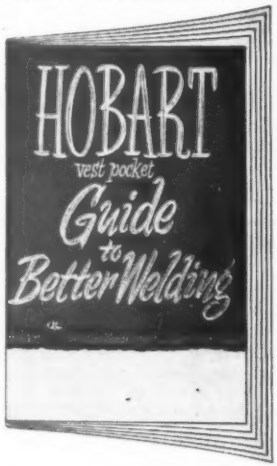
"QUALITY CONTROL METHODS", by Clifford W. Kennedy, is a compilation of the author's own experience and efforts in learning the technique known as "Statistical Methods in Quality Control". The book will give the reader an easily understood, well-balanced knowledge of the subject from both the theoretical and practical viewpoints and prepare him for the more technical and involved practices of modern Quality Control. Divided into five parts, the book covers acceptance sampling, batch control, distributions and standard deviation, average and range, and administration of methods. Charts, sample work sheets and photographs clarify the discussions. The book sells for $4.75 and is available at PRENTICE-HALL, INC., PUBLISHERS, Dept. 842, 70 Fifth Ave., New York 11, N. Y.

"PRECISION INVESTMENT CASTINGS", by Edwin Laird Cady, is a new book covering the process and products that are revolutionizing the design and manufacture of metal parts. Mr. Cady presents a thorough and comprehensive report on the advantages and limitations of precision castings, how to design parts for this process, and the best fields of application. Comparisons between precision castings and other type castings are made. Materials, shapes and finishes are analyzed; and details of the process itself are thoroughly described. Engineers, designers, metallurgists and operators will find this book invaluable. Priced at $6.00 it is available from REINHOLD PUBLISHING CORP., Dept. 63, 330 West 42nd St., New York 18, N. Y.

"MACHINING AND FINISHING LUSTRON AND LUSTREX" is a new handbook giving the most up-to-date information on machining polystyrene. Recently published by the Plastics Division of Monsanto Chemical Company, the booklet contains valuable information and instructions for operations on polystyrene articles such as: milling slots or keyways, recessing, grooving, tapping, threading, splitting, sawing or removing gates. The booklet is available from PLASTICS DIVISION, MONSANTO CHEMICAL CO., Dept. 984, Springfield, Mass., or circle **Inform-A-Gram Key No. C28.**

A POCKET-SIZE WELDER'S GUIDE, giving useful welding information, is now available free from Hobart Brothers Company, Troy, Ohio. This handy booklet gives the characteristics of various welding arcs, four essentials of proper welding procedures, type of joints, typical positions, chart of standard steel shapes, photographs of good and bad



welds, causes of common welding troubles and how to remedy them, welding symbols and a table of "How to Find" formulas. Send for your copy to THE HOBART BROS. CO., Dept. 3, Hobart Square, Troy, Ohio, or circle **Inform-A-Gram Key No. C24.**

"INTRODUCTION TO TOOL ENGINEERING" by Halsey F. Owen, M. E., Associate Professor of Industrial Engineering, Purdue University, deals with the responsibilities and duties of the tool engineer, and treats such subjects as manufacturing methods and equipment; methods and parts analysis; designing for production; manufacturing costs; tooling programs; tool design; interchangeable manufacture; and estimating cost. PRENTICE-HALL, INC., Publishers, Dept. 842, 70 Fifth Ave., New York 11, N. Y. The price is $3.60.

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MECHANICAL PROPERTIES OF HEAT TREATED NICKEL ALLOY STEELS are discussed in a recent bulletin, published by The International Nickel Co., Inc., which is a revised and enlarged edition of Bulletin P-1 issued a number of years ago. A most comprehensive and informative study, it is divided into two sections; the first covering oil and water hardening steels, and the second covering case hardened nickel alloy steel. It contains much new data, largely in the form of charts, on the properties of the more commonly used engineering steels containing up to 5% nickel. Detailed information on heat treatment methods—both for carburizing and direct-hardening compositions—along with suggested applications, makes this bulletin most valuable. THE INTERNATIONAL NICKEL CO., INC., Dept. 49, 67 Wall St., New York 5, N. Y. **Inform-A-Gram Key No. C22.**

"DESIGN OF METAL CUTTING TOOLS", by Frederick L. Woodcock, is an invaluable book filled with technical data on the basic principles of design necessary for the successful construction of tools. Based on actual shop experience, it demonstrates the practical application of the "tool to the job", how to salvage worn-out tools, how tools are made to function accurately and economically. Rules, formulas, tabular information, diagrams and many illustrations make this comprehensive study of great value not only to tool designers, engineers, draftsmen and production men, but also to students and teachers. Priced at $5.00 it is available from MCGRAW-HILL BOOK CO., INC., Dept. 56, 330 West 42nd St., New York 18, N. Y.

TO REDUCE FORMING AND DRAWING DIE TROUBLE is the purpose of a new data sheet recently released by Ampco Metal, Inc. Ampco has developed a new aluminum-bronze alloy for use in forming and drawing dies which has many times the life of steel dies. This alloy, known as Ampco 24, has high hardness, unusual compressive strength, and marked wear resistance. The data sheet covers its development, different uses, and high production records caused by its use. Send for Data Sheet No. 151 to AMPCO METAL, INC., Dept. 956, Milwaukee 4, Wis., or use our postage-free **Inform-A-Gram Key No. C23.**

VARIED APPLICATIONS OF MOLYBDENUM AS AN ALLOYING ELEMENT are described in a new book published by Climax Molybdenum Company. Entitled "Molybdenum; Steels, Irons, Alloys", the book was written by R. S. Archer, J. Z. Briggs and C. M. Loeb, Jr., and is available free of charge to all metallurgists and others connected with metallurgical industries. This 391-page comprehensive study includes sections on the following: Technical Effects of Molybdenum, Fundamental Effects of Heat Treatment on Microstructure, Addition of Molybdenum, Wrought Alloy Engineering Steels, Wrought Corrosion Resistant Steels, Wrought Steels for Elevated Temperature Service, Tool Steels, Steel Castings, Cast Iron, Special Purpose and Non-ferrous Alloys. Emphasis has been placed on the presentation of the fundamentals that must guide engineers, designers and metallurgists in the proper selection of materials for a particular application. Write for your copy to CLIMAX MOLYBDENUM CO., Dept. 64, 500 Fifth Ave., New York 18, N. Y., or circle **Inform-A-Gram Key No. C26.**

"GRAY IRON, ITS MECHANICAL AND ENGINEERING CHARACTERISTICS AND DETAILS FOR DESIGNING CAST COMPONENTS", is a new bulletin recently released by Gray Iron Founders' Society of Cleveland. This 12-page technical bulletin is intended to assist engineers in specifying and designing gray iron components or parts. It explains the fundamental considerations in designing castings, and describes the various engineering characteristics of gray iron. It is available at no cost by writing GRAY IRON FOUNDERS' SOCIETY, Dept. 28, 33 Public Square, Cleveland, Ohio, or by circling **Inform-A-Gram Key No. C25.**

A NEW BOOKLET DESCRIBING COLD FINISHED STEEL BARS has just been published by the Union Drawn Division of Republic Steel Corporation. The 28-page booklet includes typical uses and mechanical properties of the types most frequently used, including machining grades of stainless, data on commercial finishes, sizes, and tolerances. Send for your copy to REPUBLIC STEEL CORP., Dept. 27, Republic Bldg., Cleveland 1, Ohio, or circle **Inform-A-Gram Key No. C29.**

THE APPLICATIONS AND USES OF LOW-TEMPERATURE-MELTING ALLOYS are explained in detail in a new series of loose-leaf sheets recently published by Cerro de Pasco Copper Corporation. These sheets also contain illustrations of methods and uses of the alloys. They are the first of a series—others of which will be published later. Send for your copies to CERRO De PASCO COPPER CORP., Dept. 645, 40 Wall St., New York 5, N. Y., or circle **Inform-A-Gram No. C30.**

WALES HOLE PUNCHING UNITS are presented as to types in handy 8" by 11" thumb-indexed catalogs which in turn are hole-punched and encased in a handsome leatherette notebook. The various catalogs are printed in full color and contain photographs, specifications, prices, and applications of the units and important information on press brake setup methods. These catalogs are available at WALES-STRIPPIT CORP., Dept. 60, North Tonawanda, N. Y., or circle **Inform-A-Gram Key No. C31.**

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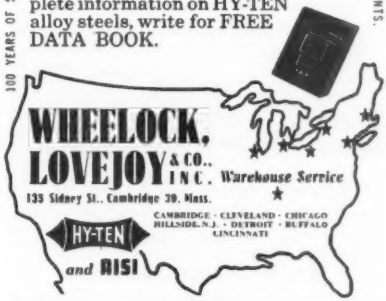

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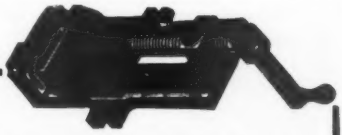

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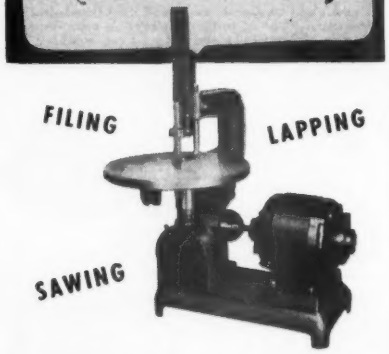

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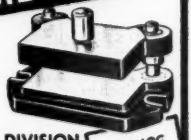

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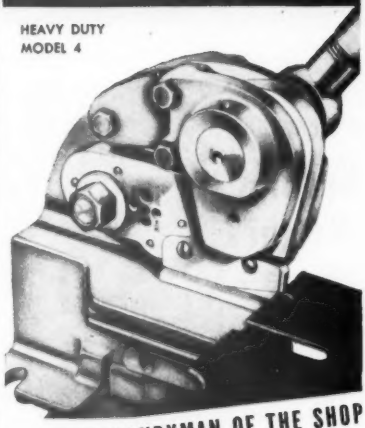

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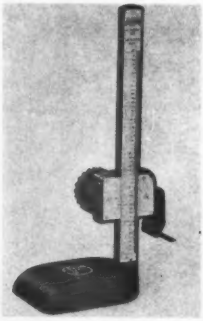

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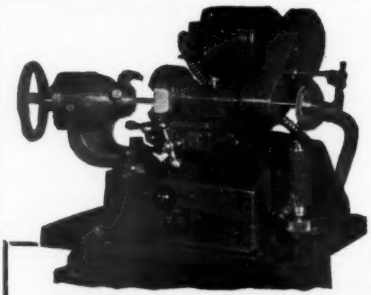

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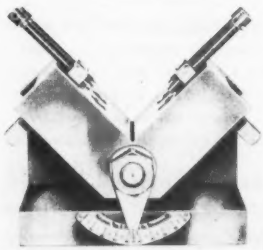

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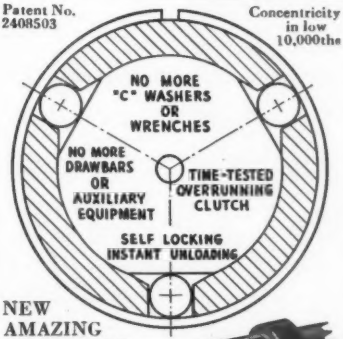
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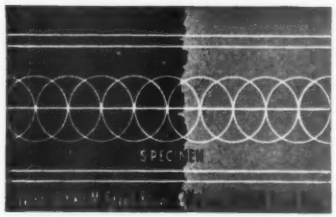

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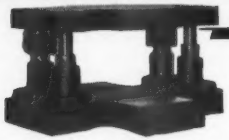

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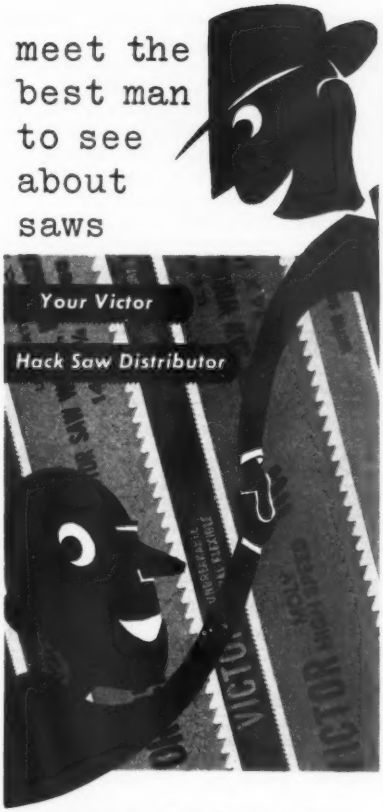

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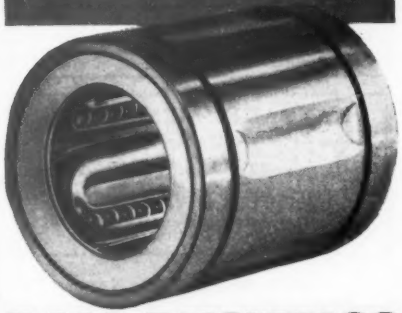

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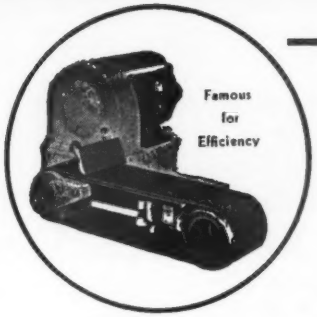

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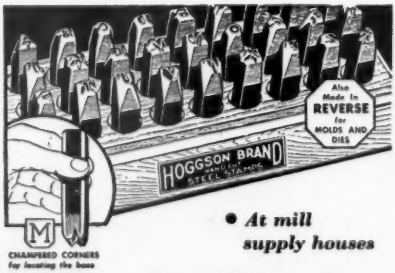

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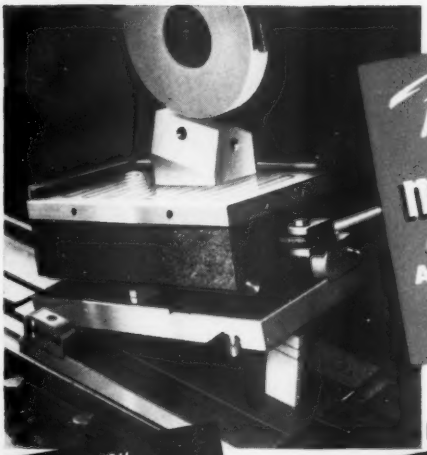

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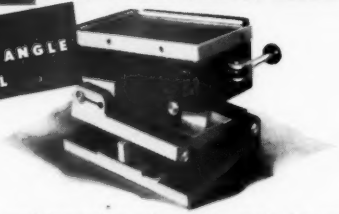

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